

INTRO TO MATTER / ATOMIC STRUCTURE

Name: _____

Period: _____

Date: _____

Matter and Mixtures Quiz

- Classify the following as a homogenous (O) or heterogeneous (E) mixture.
 - _____ A bucket of sand and water
 - _____ Air
 - _____ Human blood
 - _____ Chocolate syrup
 - _____ Sea water
- Classify each of the following as an element or a compound.
 - _____ Benzene, C_6H_6
 - _____ Aluminum, Al
 - _____ Fluorine, F_2
 - _____ Aspirin, $C_9H_8O_4$
 - _____ Titanium, Ti
- Determine which of the following are pure substances and which are mixtures.
 - _____ Salt water
 - _____ Isopropyl alcohol, C_3H_8O
 - _____ Mercury, Hg
 - _____ Ammonia, NH_3
- Classify each of the following as a physical or chemical property of sulfur.
 - _____ Its density is 2.97 g/cm^3
 - _____ It reacts with hydrogen to form a gas
 - _____ It is a yellow solid
 - _____ Its melting point is 112°C
 - _____ It combines with oxygen
- Classify each of the following as a physical change or a chemical change.
 - _____ NaCl (table salt) dissolves in water
 - _____ Silver tarnishes
 - _____ An apple is cut
 - _____ Heat changes H_2O to steam
 - _____ Baking soda reacts with vinegar
 - _____ Iron rusts
 - _____ Ice melts
 - _____ Milk sours
 - _____ Pancakes cook
 - _____ Paper towel absorbs water

6. Classify each of the pictures below by placing the correct label in the corresponding blank for each picture:

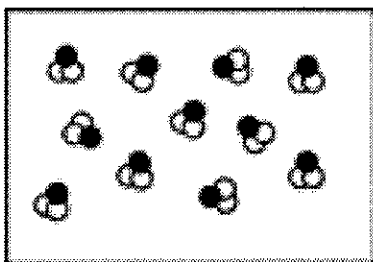
A = element

B = compound

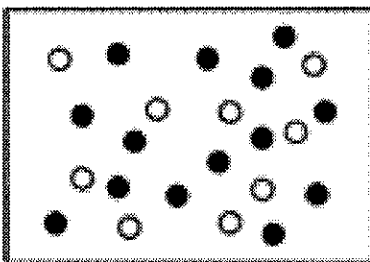
C = mixture of elements

D = mixture of compounds

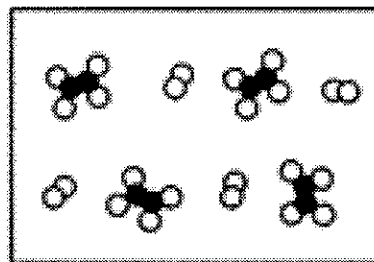
E = mixture of elements and compounds



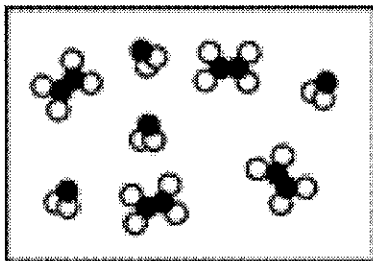
1) _____



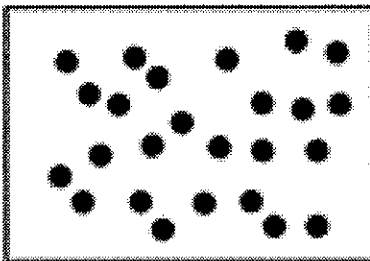
2) _____



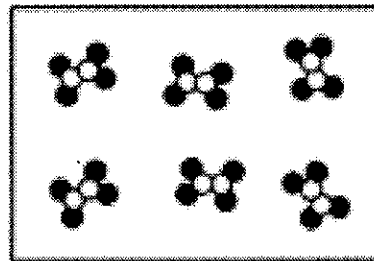
3) _____



4) _____



5) _____



6) _____

7. Identify the independent and dependent variable in each of the scenarios below.

- a. A comprehension test was given to students after they had studied textbook material either in silence or with the television turned on.
- b. Some elementary school teachers were told that a child's parents were college graduates, and other teachers were told that the child's parents had not finished high school; they then rated the child's academic potential.
- c. Spending time with a cat or dog decreases the amount of stress someone is feeling and allows them to perform better on tests.

- d. The more time people spend using social media, the less able they are to express themselves in conversation.
8. According to the periodic table, which statement correctly describes the change from a neutral atom of an element to its ion?
- A fluorine atom becomes F^{-1} by losing 1 electron
 - A sodium atom forms a Na^{+1} by losing 2 electrons
 - A magnesium atom becomes Mg^{+2} by gaining 2 electrons
 - A phosphorus atom becomes P^{-3} by gaining 3 electrons
9. Atom X has 9 protons, 10 neutrons, and 9 electrons. Atom Y has 9 protons, 9 neutrons, and 9 electrons. Which of the following statements best describes how Atom X and Atom Y are related?
- X and Y are isotopes of the same element
 - X is an ion and Y is a neutral atom
 - X and Y are different elements
 - X is neon and Y is fluorine

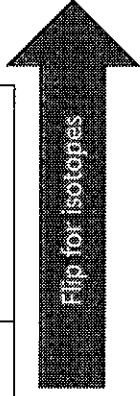
10. Complete the table below.

Element Name	Isotope Symbol	Atomic Number	Mass Number	Protons	Neutrons	Electrons
Magnesium	$^{24}_{12}Mg^{+2}$		24			
Chromium			52			24
		89	225			89
	$^{80}_{35}Br^{-1}$					
Nitrogen				7	7	10
Gold	$^{197}_{79}Au$					

Name: _____ Period: _____ Date: _____

Atomic Structure Calculations Quick Practice

Element	Isotope symbol	Atomic number	Mass number	Protons	Neutrons	Electrons
Oxygen			16			10
			40	20		18
				4	5	2
Nitrogen					7	7
	$^{35}_{17}\text{Cl}^{-1}$					
Aluminum	$^{27}_{13}\text{Al}^{+3}$					



Name: _____

Period: _____

Date: _____

Average Atomic Mass & Electron Configuration Quiz (Alpha)*Directions*

- *Show all of your work.*
- *Include units in your final answer.*
- *Put a **BOX** around your final answer.*

1. Calculate the average atomic mass of Potassium using the information in the table below.

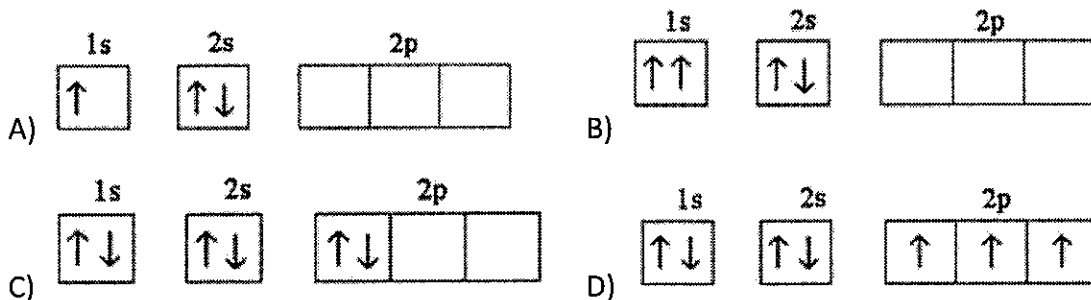
Isotope	Percent Abundance
Potassium-39	93.26%
Potassium-40	0.0117%
Potassium-41	6.73%

2. Calculate the average atomic mass of Sulfur using the information in the table below.

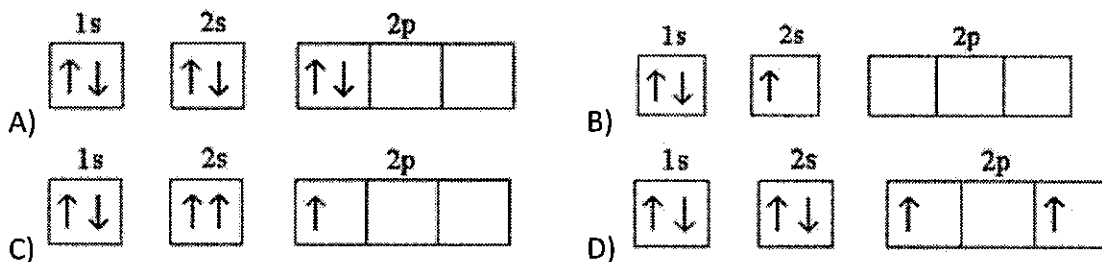
Isotope	Percent Abundance
Sulfur-32	94.93%
Sulfur-33	0.76%
Sulfur-34	4.29%
Sulfur-36	0.02%

3. Lithium has two stable isotopes. Lithium-6 has a mass of 6.015 amu and Lithium-7 has a mass of 7.016. Look up the average atomic mass of Lithium in your periodic table. Then, calculate the percent abundance of each isotope.
4. Gallium has two stable isotopes. Gallium-69 has a mass of 68.926. Gallium-71 has a mass of 70.924. Look up the average atomic mass of Gallium in your periodic table. Then, calculate the percent abundance of each isotope.

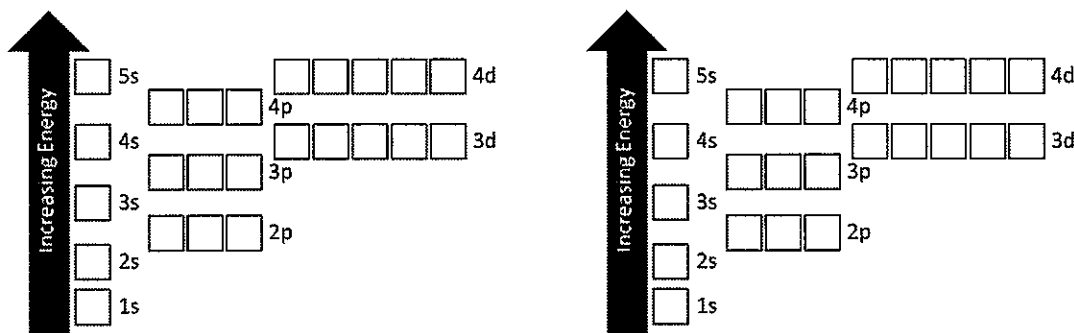
5. Which electron configuration represents a violation of Hund's rule for an atom in its ground state?



6. Which electron configuration represents a violation of the Pauli exclusion principle?

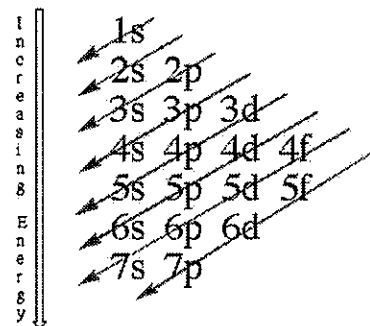


7. Draw the orbital diagrams for silicon (left) and chromium (right).



8. Write the electron configuration for each of the elements below.

- a. Potassium: _____
- b. Argon: _____
- c. Nickel: _____



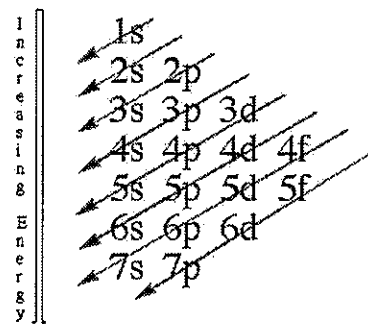
Name: _____

Period: _____

Date: _____

Honors Chemistry Electron Configuration Quiz

Determine which element is represented by each of the electron configurations below (1 point each).

1. $1s^2 2s^2 2p^6 3s^2 3p^4$ _____2. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ _____3. $[\text{Kr}] 5s^2 4d^{10} 5p^3$ _____4. $[\text{Xe}] 6s^2 4f^{14} 5d^6$ _____

Write the **full** electron configuration for each of the elements below (1 point each).

5. Vanadium: _____

6. Arsenic: _____

7. Chromium: _____

8. Silicon: _____

Write the **abbreviated** electron configuration for each of the elements below (1 point each).

9. Technetium: _____

10. Chromium: _____

11. Barium: _____

12. Osmium: _____

Determine which of the following electron configurations are invalid and explain why they are invalid.

Leave correct electron configurations blank. Complete sentences are not required (2 points per response).

13. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$ 14. $1s^2 2s^2 2p^6 3s^3 3d^5$ 15. $[\text{Kr}] 5s^2 4d^{10} 5p^5$

Part 1: Multiple Choice

Choose the best answer to each of the questions below. You may leave TWO questions blank.

1. According to the periodic table, which statement correctly describes the change from a neutral atom of an element to its ion?

A. A fluorine atom forms a F^{-1} ion by losing one electron.
B. A sodium atom forms a Na^{+1} ion by losing two electrons.
C. A magnesium atom forms a Mg^{+2} ion by gaining two electrons.
D. A phosphorus atom forms a P^{-3} ion by gaining three electrons.

2. Which of the following *best* describes an atom?

A. protons and electrons grouped together in a random pattern
B. protons and electrons grouped together in an alternating pattern
C. a core of protons and neutrons surrounded by electrons
D. a core of electrons and neutrons surrounded by protons

3. The table below shows the atomic mass of four stable calcium (Ca) isotopes.

Isotope	Atomic Mass
Ca-40	40
Ca-42	42
Ca-43	43
Ca-44	44

What characteristic is different in each isotope?

A. the position in the periodic table of the elements
B. the net charge of the nucleus
C. the mass of the protons in the nucleus
D. the number of neutrons in the nucleus

4. Results of Firing Alpha Particles at Gold Foil

Observation:	Proportion:
Alpha particles went straight through gold foil.	> 98%
Alpha particles went through gold foil but were deflected at large angles.	\approx 2%
Alpha particles bounced off gold foil.	\approx 0.01%

What information do the experimental results above reveal about the nucleus of the gold atom?

A. The nucleus contains less than half the mass of the atom.
B. The nucleus is small and is the densest part of the atom.
C. The nucleus contains small positive and negative particles.
D. The nucleus is large and occupies most of the atom's space.

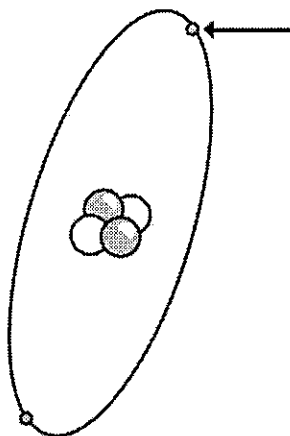
5. Study the table below.

Atom	Number of Protons	Number of Neutrons	Number of Electrons
W	3	4	3
X	53	57	53
Y	55	60	54
Z	1	0	1

Which atom has a net positive charge?

A. Atom W
B. Atom X
C. Atom Y
D. Atom Z

6. Use the picture of an atom below to answer the question.



Which statement *best* describes the part of the atom that is shown by the arrow?

7. Which of the following represents a pair of isotopes?
- A. ${}^1\text{H}$ and ${}^3\text{H}$ B. ${}^{16}\text{O}^{2-}$ and ${}^{19}\text{F}^{1-}$
- C. ${}^{40}\text{K}$ and ${}^{40}\text{Ca}$ D. ${}^{16}\text{O}^{2-}$ and ${}^{32}\text{S}^{2-}$

8. The figure below represents the periodic table and the location of four different elements on the table.

A blank periodic table grid is shown. The grid is 7 rows high and 18 columns wide. The elements are labeled as follows:

- W is in the top right corner (Row 1, Column 18).
- X is in the second row from the top right (Row 2, Column 18).
- Y is in the third row from the top, in the middle (Row 3, Column 10).
- Z is in the fourth row from the top, in the middle (Row 4, Column 10).

A certain element has a ground state electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6$. Which letter in the diagram above represents the position of this element on the periodic table?

- A. Y B. W C. X D. Z

9. Which of the following elements can form an anion that contains 54 electrons, 74 neutrons, and 53 protons?

A. (262)
Bh
107
Bohrium

B.	126.905
	I
	53
	Iodine

C.	183.85 W 74 Tungsten
----	--------------------------------------

D.

131.29
Xe
54
Xenon

10. Which of the following describes a particle that contains 36 electrons, 49 neutrons, and 38 protons?

- A. an ion with a charge of 2-
- B. an ion with a charge of 2+
- C. an atom with a mass of 38 amu
- D. an atom with a mass of 49 amu

11. Deuterium (${}^2_1\text{H}$) and protium (${}^1_1\text{H}$) are two isotopes of hydrogen. Which of the following statements *best* compares a deuterium atom to a protium atom?

- A. The deuterium atom has a smaller net charge.
- B. The deuterium atom has more electron orbitals.
- C. The deuterium atom has a smaller atomic radius.
- D. The deuterium atom has more particles in its nucleus.

12. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ is the electron configuration for which element?

- A. aluminum (Al) B. argon (Ar)
C. potassium (K) D. sodium (Na)

13. Which of the following elements has an electron configuration of $1s^2 2s^2 2p^6 3s^3 3p^1$?

A. lithium B. aluminum
C. phosphorus D. calcium

14. Which element has the electron configuration $1s^2 2s^2 2p^3$?

A. boron B. nitrogen
C. fluorine D. phosphorus

15. Cobalt has an atomic mass of 59 and an atomic number of 27. What does this information reveal about *most* cobalt atoms?

A. They contain more neutrons than protons.
B. They naturally have a net negative charge.
C. They attract protons more strongly than electrons.
D. They form ions with a charge of +27 in compounds.

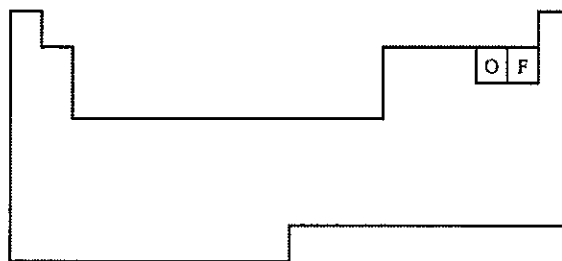
16. Which of the following subatomic particles can be found inside the nucleus of an atom?

A. electrons only
B. neutrons only
C. protons and neutrons
D. protons, neutrons, and electrons

17. Which of the following ideas was proposed by Niels Bohr?

A. Electrons occupy specific energy levels within an atom.
B. The nucleus of an atom contains neutrons as well as protons.
C. An atom is a solid sphere that cannot be separated into smaller parts.
D. An atom consists of negative charges embedded in a positively charged sphere.

18. The diagram below shows a partial periodic table.



The electron configuration of oxygen is $1s^2 2s^2 2p^4$. On the periodic table, fluorine is one space to the right of oxygen.

Which of the following electron configurations represents fluorine?

A. $1s^2 2s^2 2p^3$ B. $1s^2 2s^2 2p^5$
C. $1s^2 2s^2 2p^6 3s^2 3p^3$ D. $1s^2 2s^2 2p^6 3s^2 3p^5$

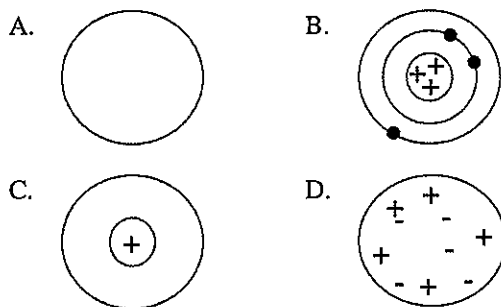
19. Which of the following is the electron configuration for sulfur?

A. $1s^2 2s^2 2p^4$ B. $1s^2 2s^2 2p^6 3s^2$
C. $1s^2 2s^2 2p^6 3s^2 3p^4$ D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

20. Which of the following identifies the number and location of protons in a lithium atom?

A. 3 protons, located in the nucleus
B. 7 protons, located in the nucleus
C. 3 protons, located in an atomic orbital
D. 7 protons, located in an atomic orbital

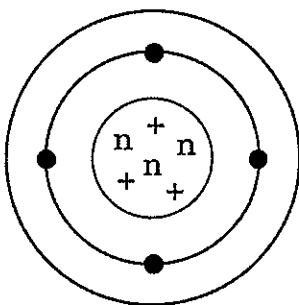
21. Which statement describes the process during which an electron in an atom emits light?
- An electron continuously gives off light as it moves within its orbit in the atom.
 - An electron absorbs light energy as it moves from a lower energy level to a higher energy level.
 - An electron releases light energy as it moves from a higher energy level to a lower energy level.
 - An electron gives off light at regular intervals as it attracts more electrons to its orbit.
22. What is the relative size and location of a proton according to the Bohr-Rutherford model of the atom?
- A proton is 2000 times more massive than an electron and is located in the nucleus.
 - A proton is 2000 times less massive than an electron and is located in the nucleus.
 - A proton is 2000 times more massive than an electron and is located in orbit around the nucleus.
 - A proton is 2000 times less massive than an electron and is located in orbit around the nucleus.
23. Which model *best* illustrates Thomson's explanation of the atom?



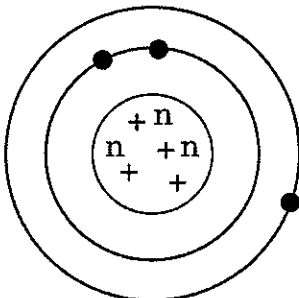
24. Which distinguishes an atom of one element from an atom of a different element?
- the number of protons
 - the number of neutrons
 - the number of electrons
 - the number of neutrons and protons
25. Which is an example of a chemical reaction?
- The melting of ice
 - The grinding of salt crystals to powder
 - The burning of wood
 - The evaporation of water from a puddle
26. An element with an atomic number of 51 and an atomic mass of 121 has how many neutrons in each atom?
- A. 51 B. 70 C. 121 D. 172

27. Which diagram represents an electrically neutral atom?

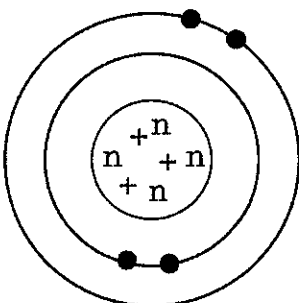
A.



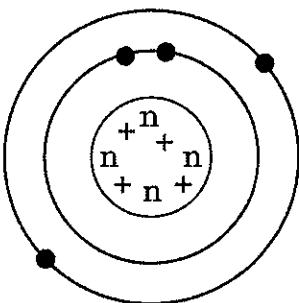
B.



C.



D.



28. What is the mass number in atomic mass units of an atom with 14 protons, 14 electrons, and 16 neutrons?

A. 14 amu B. 16 amu
C. 30 amu D. 44 amu

29. What is the atomic number of carbon-14?

A. 6 B. 7 C. 12 D. 14

30. Chlorine has two naturally occurring isotopes, chlorine-35 and chlorine-37. The atomic mass of naturally occurring chlorine is 35.45. Which statement is correct?

A. Chlorine-35 is more abundant.
B. Chlorine-37 is more abundant.
C. Chlorine-36 is more abundant.
D. Chlorine-35 and chlorine-37 are equally abundant.

31. What causes an object to have a positive charge?

A. Protons are removed.
B. Protons are added.
C. Electrons are removed.
D. Electrons are added.

32. An atom has 29 protons, 29 electrons, and 35 neutrons. What is the mass number of the atom?

A. 29 B. 35 C. 64 D. 93

33. Which describes an atom with an atomic number of 9?

A. 10 protons, 9 neutrons
B. 9 protons, 10 neutrons
C. 4 protons, 5 neutrons
D. 3 protons, 3 neutrons

34. Which conclusion can be drawn from Rutherford's gold foil experiment?
- A. The atom has a small positive center.
 - B. The atom has a small negative center.
 - C. The atom has a large positive center.
 - D. The atom has a large negative center.
35. Which of the following is an example of a physical change?
- A. A piece of iron rusts.
 - B. A piece of paper burns.
 - C. Some water freezes into ice.
 - D. Acid from a battery corrodes the surrounding metal.
36. Which type of matter is composed of two or more different elements that are chemically combined in a definite ratio?
- A. a solution
 - B. a compound
 - C. a homogeneous mixture
 - D. a heterogeneous mixture
37. An example of a physical property of an element is the element's ability to
- A. react with an acid
 - B. react with oxygen
 - C. form a compound with chlorine
 - D. form an aqueous solution
38. Which terms are used to identify pure substances?
- A. an element and a mixture
 - B. an element and a compound
 - C. a solution and a mixture
 - D. a solution and a compound
39. Which set of procedures and observations indicates a chemical change?
- A. Ethanol is added to an empty beaker and the ethanol eventually disappears.
 - B. A solid is gently heated in a crucible and the solid slowly turns to liquid.
 - C. Large crystals are crushed with a mortar and pestle and become powder.
 - D. A cool, shiny metal is added to water in a beaker and rapid bubbling occurs.
40. Which process is a chemical change?
- A. melting of ice
 - B. boiling of water
 - C. subliming of ice
 - D. decomposing of water
41. Which two substances can *not* be broken down by chemical change?
- A. C and CuO
 - B. C and Cu
 - C. CO₂ and CuO
 - D. CO₂ and Cu
42. Two solid samples each contain sulfur, oxygen, and sodium, only. These samples have the same color, melting point, density, and reaction with an aqueous barium chloride solution. It can be concluded that the two samples are the same
- A. compound
 - B. element
 - C. mixture
 - D. solution

43. Which part of a helium atom is positively charged?

- A. electron
- B. neutron
- C. nucleus
- D. orbital

44. Which of the following is *not* an example of a chemical change?

- A. A log burning
- B. A nail rusting
- C. An ice cube melting
- D. An apple rotting

45. Base your answer(s) to the following question(s) on the information below.

Archimedes (287-212 BC), a Greek inventor and mathematician, made several discoveries important to science today. According to a legend, Hiero, the king of Syracuse, commanded Archimedes to find out if the royal crown was made of gold, only. The king suspected that the crown consisted of a mixture of gold, tin, and copper.

Archimedes measured the mass of the crown and the total amount of water displaced by the crown when it was completely submerged. He repeated the procedure using individual samples, one of gold, one of tin, and one of copper. Archimedes was able to determine that the crown was not made entirely of gold without damaging it.

Identify *one* physical property that Archimedes used in his comparison of the metal samples.

Part 1: Multiple Choice 10/06/2016

1.
Answer: D

2.
Answer: C

3.
Answer: D

4.
Answer: B

5.
Answer:

6.
Answer: A

7.
Answer: A

8.
Answer: C

9.
Answer:

10.
Answer: B

11.
Answer: D

12.
Answer: C

13.
Answer: B

14.
Answer: B

15.
Answer: A

16.
Answer: C

17.
Answer: A

18.
Answer: B

19.
Answer: C

20.
Answer: A

21.
Answer: C

22.
Answer: A

23.
Answer: D

24.
Answer: A

25.
Answer: C

26.
Answer: B

27.
Answer: D

28.
Answer: C

29.
Answer: A

30.
Answer: A

31.
Answer: C

32.
Answer: C

33.
Answer: B

34.
Answer: A

35.
Answer: C

36.
Answer: B

37.
Answer: D

38.
Answer: B

39.
Answer: D

40.
Answer: D

41.

Answer: B

42.

Answer: A

43.

Answer: C

44.

Answer: C

45.

Answer: density, mass, or volume.

PERIODIC TABLE

Name: _____ Period: _____ Date: _____

Periodic Table Quiz #1

- Which color are the metals on the periodic table below? _____
- Which color are the nonmetals on the periodic table below? _____
- Which color are the metalloids on the periodic table below? _____
- Label the following periodic families on the periodic table below.
 - Alkaline earth metals
 - Transition metals
 - Halogens
 - Alkali metals
 - Noble gases

Hydrogen 1 H 1.008																	Helium 2 He 4.003				
Lithium 3 Li 6.941	Beryllium 4 Be 9.012															Boron 5 B 10.811	Carbon 6 C 12.011	Nitrogen 7 N 14.007	Oxygen 8 O 15.999	Fluorine 9 F 18.998	Neon 10 Ne 20.180
Sodium 11 Na 22.990	Magnesium 12 Mg 24.305															Aluminum 13 Al 26.982	Silicon 14 Si 28.086	Phosphorus 15 P 30.974	Sulfur 16 S 32.066	Chlorine 17 Cl 35.453	Argon 18 Ar 39.948
Potassium 19 K 39.098	Calcium 20 Ca 40.078	Scandium 21 Sc 44.956	Titanium 22 Ti 47.88	Vanadium 23 V 50.942	Chromium 24 Cr 51.996	Manganese 25 Mn 54.938	Iron 26 Fe 55.847	Cobalt 27 Co 58.933	Nickel 28 Ni 58.693	Copper 29 Cu 63.546	Zinc 30 Zn 65.39	Gallium 31 Ga 69.723	Germanium 32 Ge 72.61	Arsenic 33 As 74.922	Selenium 34 Se 78.96	Bromine 35 Br 79.904	Krypton 36 Kr 83.80				
Rubidium 37 Rb 85.468	Sr 87.62	Yttrium 38 Y 88.906	Zirconium 40 Zr 91.224	Niobium 41 Nb 92.906	Molybdenum 42 Mo 95.94	Technetium 43 Tc 97.907	Ruthenium 44 Ru 101.07	Rhodium 45 Rh 102.905	Palladium 46 Pd 106.42	Silver 47 Ag 107.868	Cadmium 48 Cd 112.411	Indium 49 In 114.82	Tin 50 Sn 118.710	Antimony 51 Sb 121.757	Tellurium 52 Te 127.60	Iodine 53 I 126.905	Xenon 54 Xe 131.29				
Cesium 55 Cs 132.905	Barium 56 Ba 137.327	Lanthanum 57 La 138.906	Hafnium 72 Hf 178.49	Tantalum 73 Ta 180.948	Tungsten 74 W 183.84	Rhenium 75 Re 186.207	Osmium 76 Os 190.2	Iridium 77 Ir 192.22	Platinum 78 Pt 195.08	Gold 79 Au 196.967	Mercury 80 Hg 200.59	Thallium 81 Tl 204.383	Lead 82 Pb 207.2	Bismuth 83 Bi 208.980	Polonium 84 Po 209	Astatine 85 At 210	Radon 86 Rn 222				
Francium 87 Fr 223	Radium 88 Ra 226	Actinium 89 Ac 227	Rutherfordium 104 Rf 261	Dubnium 105 Db 262	Seaborgium 106 Sg 266	Berkelium 107 Bk 267	Californium 108 Cf 285	Einsteinium 109 Mt 288													

5. Write the number of each property in the appropriate box below. Please write the numbers in each box in order (much easier for me to grade).

- | | | |
|--|---|---|
| 1. Bad conductor of heat and electricity | 7. Good conductor of heat and electricity | 13. Rough |
| 2. Brittle | 8. High melting point | 14. Semi-conductors |
| 3. Can be various states at room temperature | 9. Low melting point | 15. Shiny |
| 4. Do not react with water and acid | 10. Malleable | 16. Smooth |
| 5. Ductile | 11. Mix of metal and nonmetal properties | 17. Typically gas at room temperature |
| 6. Dull | 12. React with water and acid | 18. Typically solid at room temperature |

Metals	Nonmetals	Metalloids

6. Determine whether the following elements are metals, nonmetals, or metalloids. Then list the element's periodic family (alkali metal, halogen, noble gas, alkaline earth metal, or transition metal), group, and period.

Element	Metal, Nonmetal, or Metalloid	Periodic Family	Group	Period
Calcium				
Chromium				
Krypton				
Francium				

7. Jamal is looking at sneakers at Foot Locker when he discovers a very reactive, malleable, and soft element being stored in a jar of oil. Which periodic family does this element belong to?

8. Mantas is playing soccer at the neighborhood soccer field when he comes across a colorless, odorless gas. When he tries to mix the gas with other elements, it refuses to react. Which periodic family does the element belong to?

9. Melita decides to mix a certain reactive nonmetal with other substances to learn more about its properties. When she combines this nonmetal with an alkali metal, the two elements combine to form a salt. Which periodic family does the element belong to?

10. Khiya digs a hole to the center of the Earth, where she collects a sample of an element that has the ability to withstand the fires of the earth's core. This element is also present in many living organisms and is reactive. Which periodic family does it belong to?

11. Kyle decides to buy new earrings from the mall. He chooses to buy earrings made out of an element that is shiny, malleable, and located in the D block of the periodic table. Which periodic family does the element belong to?

12. Shelby decides to pull a prank on Lily so she asks her to hold a bucket of water. When Shelby adds a reactive, soft metal to the water, there is a huge explosion. Which periodic family does the element belong to?

Name: _____

Period: _____

Date: _____

Periodic Trends Quick Practice

Electronegativity is defined as

- A. radioactive level of particular electrons in chemical reactions
- B. energy released when losing an electron during a chemical reaction
- C. tendency to lose electrons in a chemical reaction
- D. tendency to gain electrons in a chemical reaction

The energy it takes to attract an electron from an atom _____ as you move across a period (row).

- A. generally increases
- B. does not change
- C. generally decreases
- D. varies unpredictably

Rank each set of atoms from biggest atomic radius to smallest atomic radius.

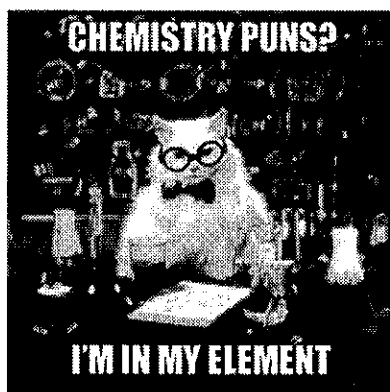
Set of Atoms	Biggest Radius	Middle	Smallest Radius
a. Li, C, F			
b. Li, Na, K			

Rank each set of atoms from greatest ionization energy to smallest ionization energy.

Set of Atoms	Most Ionization Energy	Middle	Least Ionization Energy
a. Mg, Si, S			
b. Mg, Ca, Ba			

Rank each set of atoms from greatest electronegativity to least electronegativity.

Set of Atoms	Most Electronegative		Least Electronegative
b. Mg, Si, Cl			
c. K, Cl, Ne			



Name: _____

Period: _____

Date: _____

Periodic Trends Quiz

- Rank the following elements by increasing atomic radius: carbon, aluminum, oxygen, potassium.
- Rank the following elements by increasing electronegativity: sulfur, oxygen, neon, aluminum.
- Circle the element with the **largest atomic radius**.
 - Al or B
 - Na or Al
 - S or O
- Circle the element with the **greater ionization energy**.
 - Li or Be
 - Ca or Ba
 - Na or K
- Circle the element with the **greater electronegativity**.
 - Ca or Ga
 - Br or Ar
 - Li or He
- Put the following elements in order of **increasing atomic radius**: Li, F, C
- Put the following elements in order of **decreasing electronegativity**: C, O, Ne
- Elements Z and X are compared. Element Z is larger than Element X. Based on this you could say:
 - Element Z is further to the left side of the periodic table
 - Element X is closer to the top of the periodic table
 - Element Z and X are probably in the same group
 - A and/or B
 - B and/or C
- The atomic radius of main-group elements generally increases down a group because _____.
 - effective nuclear charge increases down a group
 - effective nuclear charge decreases down a group
 - effective nuclear charge zigzags down a group
 - the principal quantum number of the valence orbitals increases
 - both effective nuclear charge increases down a group and the principal quantum number of the valence orbitals increases

10. In general, as you go across a period in the periodic table from left to right:

- (1) the atomic radius _____;
 - (2) the electronegativity _____; and
 - (3) the first ionization energy _____.
- a. decreases, decreases, increases
 - b. increases, increases, decreases
 - c. increases, increases, increases
 - d. decreases, increases, increases
 - e. decreases, increases, decreases

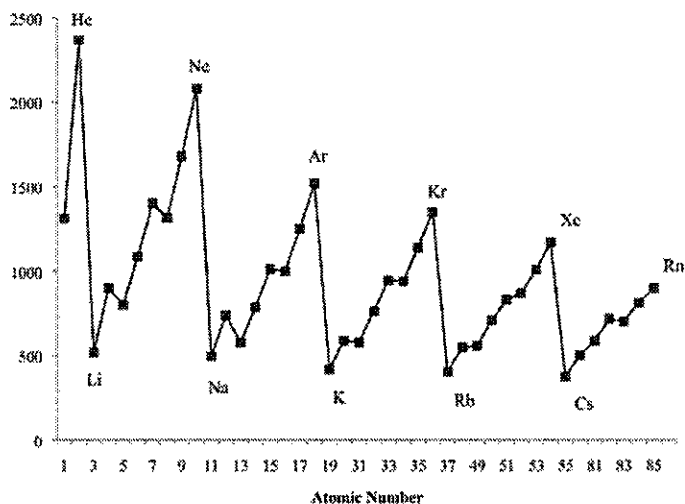
Answer questions 11-13 in complete sentences.

11. What is the difference between ionization energy and electronegativity?

12. Explain why bromine has a larger atomic radius than fluorine.

13. Explain why neon has a lower electronegativity than nitrogen.

Extra Credit: Does the graph below represent the trend for atomic radius, electronegativity, or ionization energy? You must explain why in order to receive credit.



Part 3: Multiple Choice (30 points)

1. In a comparison of metals to nonmetals, metals tend to have
 - A. lower melting points and greater conductivity than nonmetals.
 - B. lower conductivity and lower density than nonmetals.
 - C. higher density and lower melting points than nonmetals.
 - D. greater conductivity and higher melting points than nonmetals.
2. Why is cobalt (Co) placed before nickel (Ni) on the periodic table of the elements even though it has a higher average atomic mass than nickel?
 - A. Nickel has one more proton.
 - B. Cobalt was discovered first.
 - C. Nickel has fewer electrons.
 - D. Cobalt has a lower density.

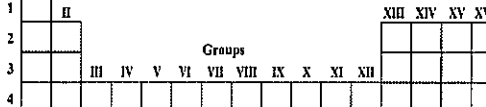
3. ☐ Periodic Table of the Elements ☐

A blank periodic table grid with the following elements labeled:

- Mn (Manganese) in the 7th period, 7th group.
- Cl (Chlorine) in the 3rd period, 17th group.
- Te (Tellurium) in the 5th period, 16th group.
- I (Iodine) in the 5th period, 17th group.
- Xe (Xenon) in the 5th period, 18th group.

Iodine would have chemical properties *most* like

4. Which of the following is the *most* important factor in determining an element's place in the periodic table?
- A. Number of protons B. Number of neutrons
- C. Atomic Charge D. Atomic Density

5. 

Different elements are *most likely* to react in similar ways when they _____.

- A. are members of the same period
- B. are members of the same group
- C. have nearly the same atomic mass
- D. have the same number of neutrons
6. Group I (the alkali metals) includes lithium (Li), sodium (Na), and potassium (K). These elements have similar chemical properties because they have the same _____.
- A. numbers of protons and neutrons
- B. numbers of electrons in the outer energy level
- C. numbers of protons in the nucleus
- D. numbers of neutrons in the nucleus
7. The pictures below show the position of different elements on the periodic table. Which picture has an X in the locations of the three elements that would be most similar in the way they react?
- A.

X		
X		
X		
- B.

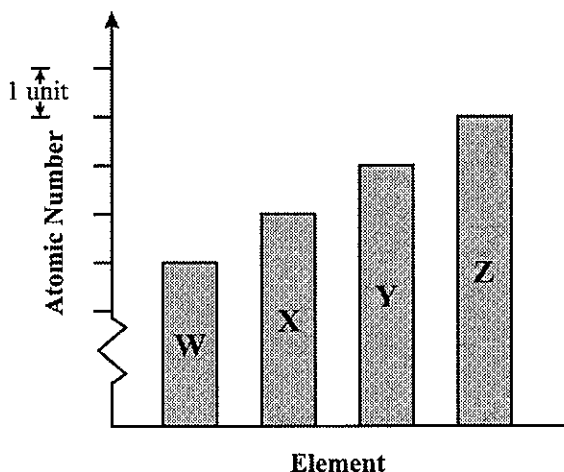
X	X	X
- C.

X		
	X	
		X
- D.

		X
	X	
X		
8. Which of the following elements has the highest electronegativity?
- A. B (boron)
- B. C (carbon)
- C. O (oxygen)
- D. N (nitrogen)
9. Which of the following correctly describes a trend from top to bottom in the group 2 (2A) elements on the periodic table?

- A. Ionic radius decreases. B. Ionic charge increases.
C. Atomic radius increases. D. Atomic number decreases.

10. The bar graph below represents four elements and their relative atomic numbers.



What would be the *most likely* positioning of these unknown elements in the periodic table?

- A. B.
- C. D.

11. Which of the following elements has characteristics of some metals and also of some nonmetals?
- A. antimony ($_{51}\text{Sb}$) B. calcium ($_{20}\text{Ca}$)
 C. sulfur ($_{16}\text{S}$) D. zinc ($_{30}\text{Zn}$)
12. Which of the following trends in the periodic table should be expected as the atomic number of the halogens increases from fluorine (F) to iodine (I)?
- A. Atomic radius decreases.
 B. Electronegativity decreases.
 C. Atomic mass decreases.
 D. Electron number decreases.
13. Which of the following sections of the periodic table contains only metals?
- A. group 2 B. group 18 C. period 2 D. period 6

14. Which of the following elements has the greatest electronegativity?

- A. hydrogen (H) B. fluorine (F)
 C. astatine (At) D. francium (Fr)

15. Which of the following statements describes properties of most metals?

- A. They have high melting and boiling points.
 B. They accept electrons to form negative ions.
 C. They have densities lower than that of water.
 D. They share electrons to form covalent bonds.

16. The table below contains a list of properties for an unidentified element, X.

Physical Characteristics	Very soft with silvery-white luster when cut
Reactivity	Ignites in air and reacts violently with cold H_2O
Some Common Compounds	XCl , X_2SO_4 , X_3PO_4 , XOH , X_2O
Melting Point ($^{\circ}\text{C}$)	39.1
Boiling Point ($^{\circ}\text{C}$)	688

Based on the properties in the table, to which of the following groups from the periodic table does element X *most likely* belong?

- A. 1 (1A) B. 2 (2A) C. 14 (4A) D. 16 (6A)
17. Which of the following materials would probably be used as a conductor of electric current in a computer chip?
- A. glass B. rubber C. gold D. plastic
18. Which of the following statements explains why elements of the alkali metal family are highly reactive?
- A. Alkali metals are easily ionized.
 B. Alkali metals are negatively charged.
 C. Alkali metals have an odd number of protons.
 D. Alkali metals have an odd number of electrons.
19. In which of the following lists are the elements shown in order of increasing electronegativity?
- A. Li, Be, O, F B. O, F, Be, Li
 C. F, Li, O, Be D. Li, F, Be, O

20. The table below provides some information about an unidentified element.

Physical Properties: <ul style="list-style-type: none"> shiny silver-colored solid easily flattened with small hammer denser than water has 4 valence electrons
Chemical Properties: <ul style="list-style-type: none"> does not react with sodium reacts slowly with oxygen

Based on this information, the unidentified element is *best* classified as which of the following?

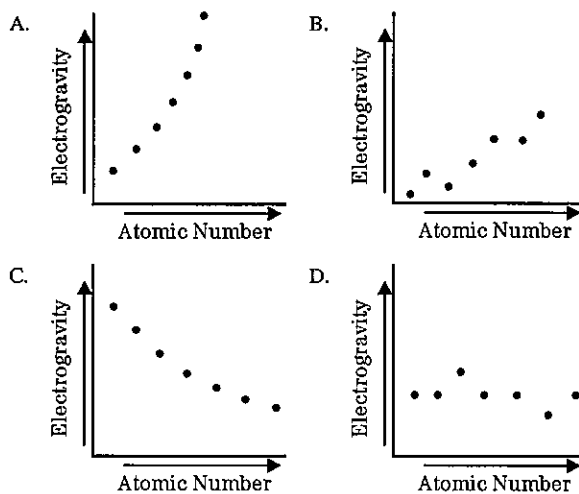
- A. a metal in group 1 (1A) B. a metal in group 14 (4A)
 C. a nonmetal in period 4 D. a metalloid in period 5
21. The diagram below shows the relative locations of five unidentified elements in the periodic table: E, X, G, J, and L.

E		X		G
			J	
		L		

Element X has an atomic number of z . Which unidentified element has an atomic number of $z + 2$?

- A. element E B. element G
 C. element J D. element L
22. Which element in Period 2 has the greatest tendency to form a negative ion?
- A. lithium B. carbon C. neon D. fluorine
23. Which element in Period 3 has the greatest tendency to gain electrons?
- A. Na B. Si C. Cl D. Ar
24. As the elements in Group 2 (IIA) of the Periodic Table are considered from top to bottom, the chemical reactivity of each succeeding element generally
- A. decreases B. increases
 C. remains the same
25. The highest ionization energies in any period are found in Group
- A. 1 (IA) B. 2 (IIA)
 C. 17 (VIIA) D. 18 (O)

26. Which element within any given period of the Periodic Table would always have the *lowest* first ionization energy?
- A. an alkali metal B. a halogen
 C. an alkaline earth metal D. a noble gas
27. Of all the elements, the one with the highest electronegativity is found in Period
- A. 1 B. 2 C. 3 D. 4
28. Which of the Group 15 (VA) elements can lose an electron most readily?
- A. N B. P C. Sb D. Bi
29. As the Group 1 (IA) elements of the Periodic Table are considered from top to bottom, the first ionization energy of each successive element decreases. One reason for this is that the
- A. nuclear charge is decreasing
 B. number of neutrons is increasing
 C. number of principal energy levels is decreasing
 D. distance between the valence electron and the nucleus is increasing
30. Which diagram correctly shows the relationship between electronegativity and atomic number for the elements of Period 3?



Part 3: Multiple Choice (30 points) 11/09/2016

1.
Answer: D

2.
Answer: A

3.
Answer: C

4.
Answer: A

5.
Answer: B

6.
Answer:

7.
Answer: A

8.
Answer: C

9.
Answer: C

10.
Answer: D

11.
Answer: A

12.
Answer: B

13.
Answer: A

14.
Answer: B

15.
Answer: A

16.
Answer: A

17.
Answer: C

18.
Answer: A

19.
Answer: A

20.
Answer: B

21.
Answer: B

22.
Answer: D

23.
Answer: C

24.
Answer: B

25.
Answer: D

26.
Answer: A

27.
Answer: B

28.
Answer: D

29.
Answer: D

30.
Answer: A

Name: _____

Period: _____

Date: _____

Honors Chemistry Final Exam Study Guide

Unit	Subtopics
Introduction to Matter	<ul style="list-style-type: none"> • Atoms vs. elements vs. compounds • Mixtures vs. pure substances • Heterogeneous and homogenous mixtures • Chemical and physical properties • Chemical and physical changes
Atomic Structure	<ul style="list-style-type: none"> • Basic contributions of Democritus, Dalton, Thomson, Rutherford, and Bohr • Difference between atoms, elements, and compounds • Location of protons, neutrons, and electrons • Calculate protons, neutrons, electrons in <u>neutral atoms</u> and <u>ions</u> • Cations vs. anions • Isotopes • Average atomic mass • Electron configuration and orbital diagrams (including Hund's/Pauli exclusion/Aufbau)
Periodic Table	<ul style="list-style-type: none"> • Groups vs. periods • Properties of metals and nonmetals • Properties of alkali metals, alkaline earth metals, transition metals, halogens, and noble gases • Charges of elements on the periodic table • Valence electrons of elements on the periodic table • Periodic trends (atomic radius, electronegativity, ionization energy)
Chemical Bonding	<ul style="list-style-type: none"> • Properties of ionic and covalent compounds • Naming covalent, ionic, polyatomic, and transition metal compounds • Lewis dot diagrams for compounds containing single, double, or triple bonds (including polyatomic ions) • VSEPR theory
Chemical Reactions	<ul style="list-style-type: none"> • Law of Conservation of Matter • Balancing equations • Identifying types of chemical reactions • Predicting the products of synthesis, decomposition, single replacement, and double replacement reactions • Precipitation reactions (solubility rules) and using the activity series of metals • REDOX reactions • Collision theory/factors affecting reaction rate
Moles and Stoichiometry	<ul style="list-style-type: none"> • Mole conversions • Percent composition • Percent error • Empirical formulas • Molecular formulas • Stoichiometry • Limiting reagents, excess reagents, and percent yield
Acids and Bases	<ul style="list-style-type: none"> • Identifying Brønsted-Lowry acids, bases, conjugate acids, and conjugate bases • pH/pOH calculations • Strong acids and bases • Neutralization reactions • Titration calculations

+ VSEPR

Polyatomic Ions	
NH_4^{+1}	Ammonium
CO_3^{-2}	Carbonate
ClO_3^{-1}	Chlorate
SO_4^{-2}	Sulfate
$\text{C}_2\text{H}_3\text{O}_2^{-1}$	Acetate
OH^{-1}	Hydroxide
CN^{-1}	Cyanide
PO_4^{-3}	Phosphate
NO_3^{-1}	Nitrate
HCO_3^{-1}	Bicarbonate
ClO_4^{-1}	Perchlorate
MnO_4^{-1}	Permanganate
CrO_4^{-2}	Chromate
NO_2^{-1}	Nitrite
$\text{Cr}_2\text{O}_7^{-2}$	Dichromate
ClO_2^{-1}	Chlorite

YOU'RE REALLY
GREAT AND I ONLY
WANT GOOD
THINGS TO
HAPPEN
TO YOU.

IF YOU'RE MAKING

Mistakes

it means

YOU'RE OUT THERE

Doing

Something.

e

Neil Gaiman

Repeat after me:
I am
STRONGER
than this challenge.
And this challenge
is making me even
STRONGER

DON'T GIVE
UP WHAT
YOU WANT
MOST
FOR WHAT
YOU WANT
NOW

Hydrogen 1 H 1.008																	Helium 2 He 4.003						
Lithium 3 Li 6.941	Beryllium 4 Be 9.012																	Boron 5 B 10.811	Carbon 6 C 12.011	Nitrogen 7 N 14.007	Oxygen 8 O 15.999	Fluorine 9 F 18.998	Neon 10 Ne 20.180
Sodium 11 Na 22.990	Magnesium 12 Mg 24.305																	Aluminum 13 Al 26.982	Silicon 14 Si 28.086	Phosphorus 15 P 30.974	Sulfur 16 S 32.066	Chlorine 17 Cl 35.453	Argon 18 Ar 39.948
Potassium 19 K 39.098	Calcium 20 Ca 40.078	Scandium 21 Sc 44.956	Titanium 22 Ti 47.88	Vanadium 23 V 50.942	Chromium 24 Cr 51.996	Manganese 25 Mn 54.938	Iron 26 Fe 55.847	Cobalt 27 Co 58.933	Nickel 28 Ni 58.693	Copper 29 Cu 63.546	Zinc 30 Zn 65.39	Gallium 31 Ga 69.723	Germanium 32 Ge 72.61	Arsenic 33 As 74.922	Selenium 34 Se 78.96	Bromine 35 Br 79.904	Krypton 36 Kr 83.80						
Rubidium 37 Rb 85.468	Strontium 38 Sr 87.62	Yttrium 39 Y 88.906	Zirconium 40 Zr 91.224	Niobium 41 Nb 92.906	Molybdenum 42 Mo 95.94	Technetium 43 Tc 97.907	Ruthenium 44 Ru 101.07	Rhodium 45 Rh 102.906	Palladium 46 Pd 106.42	Silver 47 Ag 107.868	Cadmium 48 Cd 112.411	Indium 49 In 114.82	Tin 50 Sn 118.710	Antimony 51 Sb 121.757	Tellurium 52 Te 127.60	Iodine 53 I 126.904	Xenon 54 Xe 131.290						
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Francium 87 Fr 223.020	Radium 88 Ra 226.025	Actinium 89 Ac 227.028	Rutherfordium 104 Rf (261)	Dubnium 105 Db (262)	Seaborgium 106 Sg (263)	Bohrium 107 Bh (262)	Hassium 108 Hs (265)	Meitnerium 109 Mt (266)															

SOLUBILITY TABLE

	Ions	Solubility
GENERALLY SOLUBLE	Alkali metals, NH_4^+ , NO_3^- , ClO_3^- , ClO_4^- , $\text{C}_2\text{H}_3\text{O}_2^-$, HCO_3^-	Always soluble
	Halogens	Soluble EXCEPT with Ag, Pb, Hg, Cu^{+1}
	SO_4^{-2}	Soluble EXCEPT with Ca, Sr, Ba, Pb
GENERALLY INSOLUBLE	O^{-2} , OH^-	Insoluble EXCEPT with Ba, Ca, Sr, and alkali metals
	CO_3^{-2} , PO_4^{-3} , S^{-2} , SO_3^{-2} , $\text{C}_2\text{O}_4^{-2}$, CrO_4^{-2} 2	Insoluble EXCEPT with alkali metals and NH_4^+

*HALOGENS = F, Cl, Br, I, At,

*ALKALI METALS = Li, Na, K, Rb, Cs, Fr

ACTIVITY SERIES:

Metal	Oxidation Reaction				
Lithium	Li	\rightleftharpoons	Li^+	+	e^-
Rubidium	Rb	\rightleftharpoons	Rb^+	+	e^-
Potassium	K	\rightleftharpoons	K^+	+	e^-
Barium	Ba	\rightleftharpoons	Ba^{2+}	+	2e^-
Calcium	Ca	\rightleftharpoons	Ca^{2+}	+	2e^-
Sodium	Na	\rightleftharpoons	Na^+	+	e^-
Magnesium	Mg	\rightleftharpoons	Mg^{2+}	+	2e^-
Aluminum	Al	\rightleftharpoons	Al^{3+}	+	3e^-
Manganese	Mn	\rightleftharpoons	Mn^{2+}	+	2e^-
Zinc	Zn	\rightleftharpoons	Zn^{2+}	+	2e^-
Chromium	Cr	\rightleftharpoons	Cr^{3+}	+	3e^-
Iron	Fe	\rightleftharpoons	Fe^{2+}	+	2e^-
Cobalt	Co	\rightleftharpoons	Co^{2+}	+	2e^-
Nickel	Ni	\rightleftharpoons	Ni^{2+}	+	2e^-
Tin	Sn	\rightleftharpoons	Sn^{2+}	+	2e^-
Lead	Pb	\rightleftharpoons	Pb^{2+}	+	2e^-
Hydrogen	H_2	\rightleftharpoons	2H^+	+	2e^-
Copper	Cu	\rightleftharpoons	Cu^{2+}	+	2e^-
Silver	Ag	\rightleftharpoons	Ag^+	+	e^-
Mercury	Hg	\rightleftharpoons	Hg^{2+}	+	2e^-
Platinum	Pt	\rightleftharpoons	Pt^{2+}	+	2e^-
Gold	Au	\rightleftharpoons	Au^{3+}	+	3e^-

Metals at the top of the table are most easily oxidized.

RULES FOR ASSIGNING OXIDATION NUMBERS:

1. The oxidation number of a monatomic ion is equal to its ionic charge. For example, the oxidation number of bromide is -1 and the oxidation number of calcium is +2.
2. The oxidation number of hydrogen in a compound is +1.
3. The oxidation number of oxygen in a compound is -2, except for in compounds with the more electronegative fluorine, where it is positive.
4. The oxidation number of an atom in uncombined (elemental) form is zero. For example, the oxidation number of potassium atoms in potassium metal (K) or of the nitrogen atoms in nitrogen gas (N_2) is zero.
5. For any neutral compound, the sum of the oxidation numbers of the atoms in the compound must equal zero.



BONDING

Name: _____

Period: _____

Date: _____

Properties of Ionic, Covalent, and Metallic Bonds

Chemical Bonding Test Review

Characterize each property as ionic (I) or covalent (C).

- | | |
|--|--|
| 1. _____ 2 nonmetals | 7. _____ High melting point |
| 2. _____ Conducts electricity | 8. _____ Low boiling point |
| 3. _____ Crystalline solids | 9. _____ Made of cations and anions |
| 4. _____ Electrons are shared | 10. _____ Metal + nonmetal |
| 5. _____ Electrons are transferred from
cation (metal) to anion (metal) | 11. _____ More soluble in water |
| 6. _____ Hard | 12. _____ Poor conductors of electricity |
| | 13. _____ Soft |
-

14. Magnesium bromide is a(n) _____ compound
- | | |
|-------------|----------------------|
| a. Metallic | c. Ionic |
| b. Covalent | d. None of the above |
15. How is the bond in F_2 different from the bond in KCl?
- | | |
|---------------------------------------|---------------------------------------|
| a. F_2 is covalent and KCl is ionic | c. F_2 is ionic and KCl is covalent |
| b. F_2 is ionic and KCl is ionic | |
16. An atom that has gained or lost electrons becomes a(n)
- | | |
|-------------|------------|
| a. Electron | c. Isotope |
| b. Proton | d. Ion |
17. Nonmetals tend to _____ electrons to become _____.
- | | |
|-------------------|-------------------|
| a. Lose, positive | c. Lose, neutral |
| b. Gain, negative | d. Gain, positive |
18. When a sodium atom loses one electron, it gets a charge of _____
- | | |
|-------|-------|
| a. +1 | c. 0 |
| b. -1 | d. +2 |
19. Hydrogen monofluoride has a(n) _____ bond and its chemical formula is _____.
- | | |
|-----------------|---------------------|
| a. Covalent, HF | c. Covalent, H_2F |
| b. Ionic, HF | |

Name: _____

Period: _____

Date: _____

Chemical Nomenclature & Lewis Dot Diagram Quiz

Complete the table below (2 points each).

Name	Chemical Formula
Ammonium cyanide	
Copper (III) sulfate	
Lead (II) bicarbonate	
Potassium phosphate	
Octaphosphorus pentachloride	
	NiO
	H ₃ P ₁₀
	Ga(OH) ₃
	AgNO ₂
	MgS

Draw the Lewis Dot Diagrams for each of the following compounds. These compounds could include single, double, or triple bonds (3 points each).

CO ₃ ⁻² VEs:	SiF ₃ ⁻¹ VEs:
CH ₂ O VEs:	N ₂ VEs:

Name: _____

Period: _____

Date: _____

Honors Chemistry Chemical Nomenclature Quiz

Write the formulas for each of the following compounds.

1. ammonium sulfide _____

2. aluminum acetate _____

3. sodium nitrate _____

4. calcium chloride _____

5. barium chromate _____

6. aluminum sulfate _____

7. potassium iodide _____

8. potassium nitrate _____

9. barium chloride _____

10. lead(IV) chlorite _____

11. sulfuric acid _____

12. lead(II) phosphate _____

13. potassium hydroxide _____

14. lead(II) nitrite _____

15. diphosphorus pentoxide _____

16. potassium dichromate _____

17. magnesium carbonate _____

18. calcium fluoride _____

19. calcium bicarbonate _____

20. aluminum hydroxide _____

21. ammonium chromate _____

22. tin(II) chloride _____

23. barium carbonate _____

24. nitrogen triiodide _____

25. calcium iodide _____

26. sulfur trioxide _____

27. ammonium dichromate _____

28. magnesium hydroxide _____

29. iron(III) bicarbonate _____

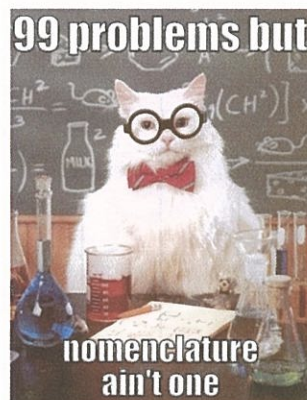
30. ammonium perchlorate _____

31. nickel(II) acetate _____

32. sodium chromate _____

33. sodium nitrite _____

34. iron(II) chromate _____



**my apologies for the
incorrect grammar*

35. potassium permanganate _____
36. magnesium oxide _____
37. potassium phosphate _____
38. oxygen difluoride _____
39. lead(II) chlorite _____
40. acetic acid _____
41. nitric acid _____
42. magnesium nitrate _____

Name each of the following compounds.

51. HgF_2 _____
52. KF _____
53. N_2O_5 _____
54. NaOH _____
55. $\text{Be}(\text{ClO}_4)_2$ _____
56. KCl _____
57. CaSO_4 _____
58. NI_3 _____

43. iron(II) chromate _____
44. chromium(II) bicarbonate _____
45. sodium hydroxide _____
46. hydrobromic acid _____
47. mercury(II) nitrate _____
48. hydrocyanic acid _____
49. calcium chlorate _____
50. hydrochloric acid _____

59. $\text{Hg}(\text{OH})_2$ _____
60. $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ _____
61. KMnO_4 _____
62. HCl _____
63. Al_2O_3 _____
64. ClF_3 _____
65. KClO_4 _____
66. CuCO_3 _____

Name: _____

Period: _____

Date: _____

Lewis Dot Diagram & VSEPR Quiz

For each of the following molecules:

1. Calculate the number of valence electrons
2. Draw the Lewis Dot Diagram.
3. Determine the VSEPR shape.
4. Draw the VSEPR shape.
5. Label the bond angle.

Molecule	Valence Electrons	Lewis Dot Diagram	VSEPR Name	VSEPR Diagram	Bond Angle
CBr_4					
SiO_2					
NO_3^{-1}					

Molecule	Valence Electrons	Lewis Dot Diagram	VSEPR Name	VSEPR Diagram	Bond Angle
PCl_3					
SeBr_2					

How is molecular shape determined?

- A. By the repulsion of the protons in the bonded atoms
- B. By the repulsion of the electron pairs in the bonded atoms
- C. By the number of ionic bonds and lone pairs in a compound
- D. By the number of neutrons in the bonded atoms

Name: _____

Period: _____

Date: _____

Chemical Bonding Test

Honors Chemistry

Chemical Nomenclature

If given the name of a compound, write the formula. If given the formula, write the compound's name.

1. nitrogen triiodide _____

2. silver (I) oxide _____

3. iron (II) sulfide _____

4. $\text{Ba}(\text{OH})_2$ _____5. PbS _____6. MgF_2 _____7. NO _____

8. lead (IV) oxide _____

9. calcium phosphide _____

10. copper (II) sulfate _____

11. HNO_3 _____12. HNO_2 _____13. HMnO_4 _____

14. hydroiodic acid _____

15. chlorous acid _____



Lewis Dot Diagrams and VSEPR Theory

For each of the following molecules:

1. Calculate the number of valence electrons
2. Draw the Lewis Dot Diagram.
3. Determine the VSEPR shape.
4. Draw the VSEPR shape.
5. Label the bond angle.
6. Label each element's partial charge (on its VSEPR diagram).
7. Classify the molecule as polar or nonpolar.

Chemical Formula	Valence Electrons	Lewis Dot Diagram	Name of VSEPR Shape	VSEPR Drawing, Bond Angle, and Partial Charges	Polar or Nonpolar
NO_2^{-1}					
SH_2					
SO_4^{-2}					
NO_2^{+1}					

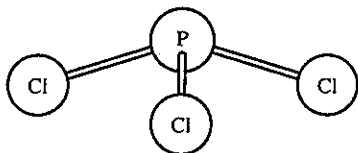
Short Answer

Answer the following questions in complete sentences.

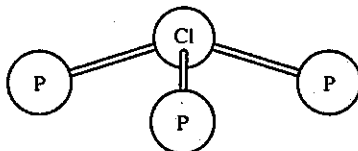
1. For the following collection of nonmetallic elements: **O, P, I, Mg, Al**
 - a. Which two would form the most polar single bond (remember that ionic compounds cannot be polar)? Explain.
 - b. Which two would be likely to form a compound of formula XY_2 ? Explain.
 - c. Which combinations of elements would likely yield a compound with the formula X_2Y_3 ? Explain.
2. Explain why the following ions have different bond angles: ClO_2^{-1} and NO_2^{-1} (discuss VSEPR theory, not just # of bonds/lone pairs).

1. Which of the following models correctly represents the compound phosphorus trichloride (PCl_3)?

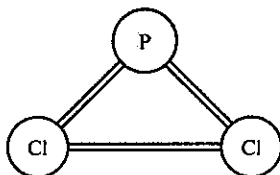
A.



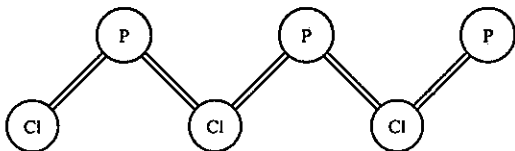
B.



C.



D.



2. When cations and anions join, they form what kind of chemical bond?

- A. ionic B. hydrogen
C. metallic D. covalent

3. Which of the following correctly shows how carbon and hydrogen bond to form a compound?

- A. $[4\text{H}]^{+4}[\text{C}]^{-4}$ B. $[\text{H}]^{+}[\text{C}]^{-}$
C. D. $\text{C}-\text{H}$

4. Some of the molecules found in the human body are $\text{NH}_2\text{CH}_2\text{COOH}$ (glycine), $\text{C}_6\text{H}_{12}\text{O}_6$ (glucose), and $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ (stearic acid). The bonds they form are

- A. nuclear. B. metallic.
C. ionic. D. covalent.

5. The reason salt crystals, such as KCl , hold together so well is because the cations are strongly attracted to

- A. neighboring cations.
B. the protons in the neighboring nucleus.
C. free electrons in the crystals.
D. neighboring anions.

6. Metals and nonmetals generally form ionic bonds with each other. Which of the following sets of elements will *most likely* for an ionic bond?

- A. Na, F B. Cl, F C. Na, K D. He, O

7. Consumers use many products made of plastic. Plastics are carbon-based polymers made from smaller carbon compounds, called monomers.

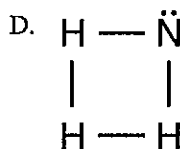
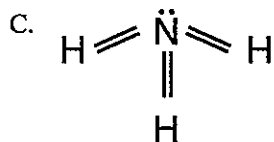
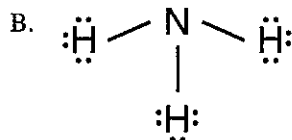
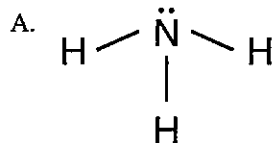
Common Plastics

Plastic	Monomer	Polymer
Polyethylene		
Polypropylene		

In organic molecules, the carbon atoms and the hydrogen atoms are held together by _____.

- A. hydrogen bonds B. covalent bonds
C. ionic bonds D. nuclear bonds

8. The chemical formula for ammonia is NH_3 . Which of the following is the correct Lewis electron dot structure for ammonia?



9. Limestone is a naturally occurring form of calcium carbonate. The correct formula for limestone is

- A. $\text{Ca}(\text{CO}_3)_2$. B. CaCO_3 .
C. Ca_2CO_3 . D. $\text{Ca}_2(\text{CO}_3)_2$.

10. The correct name for an aqueous solution of HCl is

- A. chloric acid. B. chlorous acid.
C. hydrochloric acid. D. hydrogen chloride.

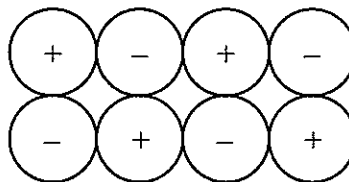
11. When elements from group 1 (1A) combine with elements from group 17 (7A), they produce compounds. Which of the following is the correct combining ratio between group 1 (1A) elements and group 17 (7A) elements?

- A. 1:1 B. 1:2 C. 2:1 D. 3:2

12. Soda ash, or sodium carbonate, is used in glassmaking. It is composed of sodium ions and carbonate ions. Which of the following is the chemical formula of sodium carbonate?

- A. NaCO_3 B. Na_2CO_3
C. $\text{Na}_4\text{C}_2\text{O}_6$ D. $\text{Na}(\text{CO}_3)_2$

13. The diagram below represents particles of different elements in a crystal.



What type of bond holds these particles together?

- A. covalent B. hydrogen
C. ionic D. polar

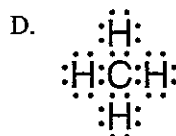
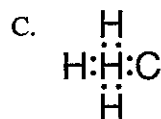
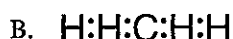
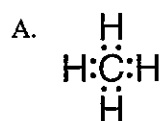
14. What is the *correct* name for the compound with the chemical formula NH_4NO_3 ?

- A. ammonium nitrate
B. hydro-nitrogen oxide
C. ammonia mononitrite
D. nitro-hydrogen nitrate

15. Oxygen (O) atoms have six valence electrons and beryllium (Be) atoms have two valence electrons. Which of the following is the *correct* formula for a compound made of oxygen and beryllium?

- A. BeO B. BeO_2
C. BeO_2 D. Be_2O_6

16. Which of the following Lewis dot structures represents the compound methane (CH_4)?



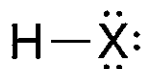
17. What is the correct formula for aluminum oxide?

A. AlO_2 B. Al_2O_3 C. Al_3O_2 D. Al_3O_6

18. Which of the following statements explains why the bond in hydrogen chloride (HCl) is polar covalent?

- A. The atomic mass of chlorine is greater than that of hydrogen.
 B. The electronegativity of chlorine is greater than that of hydrogen.
 C. The diameter of a chlorine atom is greater than that of a hydrogen atom.
 D. The number of valence electrons in a chlorine atom is greater than that in a hydrogen atom.

19. The Lewis dot structure of a compound is shown below.



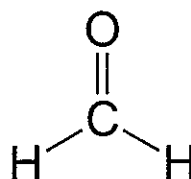
Which of the following elements does X represent in the structure?

- A. carbon (C) B. nitrogen (N)
 C. oxygen (O) D. fluorine (F)

20. Which of the following statements *best* explains why atoms bond?

- A. Atoms bond to make new substances.
 B. Atoms bond to become less chemically stable.
 C. Atoms bond to change from a liquid to a solid.
 D. Atoms bond to become more chemically stable.

21. The chemical structure of formaldehyde is shown below.



What is the geometry around the carbon atom?

- A. bent B. linear
 C. tetrahedral D. trigonal planar

22. Two elements in a molecule have the same electronegativity values. Which of the following *most likely* holds the elements together and why?

- A. an ionic bond, because electrons transfer from one element to the other
 B. a nonpolar covalent bond, because the elements share electrons equally
 C. a polar covalent bond, because the elements do not share electrons equally
 D. an intermolecular force, because the elements do not form a chemical bond

23. What is the chemical formula for ammonium sulfate?

- A. NH_4SO_4 B. $\text{NH}_4(\text{SO}_4)_2$
 C. $\text{NH}_4(\text{SO}_4)_3$ D. $(\text{NH}_4)_2\text{SO}_4$

24. In a hydrogen fluoride (HF) molecule, a hydrogen atom and a fluorine atom are held together by a polar covalent bond. Which of the following *best* explains why this bond is polar?

- A. the large difference in the atomic radii of hydrogen and fluorine atoms
- B. the large difference in the atomic masses of hydrogen and fluorine atoms
- C. the large difference in the electronegativities of hydrogen and fluorine atoms
- D. the large difference in the number of electrons of hydrogen and fluorine atoms

25. Which of the following occurs in an ionic bond?

- A. Two ions share protons.
- B. Two ions share electrons.
- C. Similarly charged ions attract.
- D. Oppositely charged ions attract.

26. Carbon forms covalent bonds with many different elements.

- a) Describe the difference between a nonpolar covalent bond and a polar covalent bond.
- b) Using electronegativity trends in the periodic table, rank the three covalent bonds shown below in order from least polar to most polar. Explain your reasoning.

C-N C-C C-O

- c) Identify one covalent bond from the previous part in which the carbon atom has a partial positive charge. Explain your answer.

1. A characteristic of ionic solids is that they

- A. have high melting points
- B. have low boiling points
- C. conduct electricity
- D. are noncrystalline

2. A chemist performs the same tests on two homogeneous white crystalline solids, A and B. The results are shown in the accompanying table.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H ₂ O (grams per 100.0 g H ₂ O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

- A. both solids contain only ionic bonds
- B. both solids contain only covalent bonds
- C. solid A contains only covalent bonds and solid B contains only ionic bonds
- D. solid A contains only ionic bonds and solid B contains only covalent bonds

3. Which statement explains why a molecule of CH₄ is nonpolar?

- A. The bonds between the atoms in a CH₄ molecule are polar.
- B. The bonds between the atoms in a CH₄ molecule are ionic.
- C. The geometric shape of a CH₄ molecule distributes the charges symmetrically.
- D. The geometric shape of a CH₄ molecule distributes the charges asymmetrically.

4. Which molecule contains a nonpolar covalent bond?

- A. HCl B. F₂ C. CO₂ D. NH₃

5. When ionic bonds are formed, metallic atoms tend to

- A. lose electrons and become negative ions
- B. lose electrons and become positive ions
- C. gain electrons and become negative ions
- D. gain electrons and become positive ions

6. In a nonpolar covalent bond, electrons are

- A. located in a mobile "sea" shared by many ions
- B. transferred from one atom to another
- C. shared equally by two atoms
- D. shared unequally by two atoms

7. Which pair of atoms will share electrons when a bond is formed between them?

- A. Ba and I B. Br and Cl
C. K and Cl D. Li and I

8. Which substance is correctly paired with its type of bonding?

- A. NaBr—nonpolar covalent
- B. HCl—nonpolar covalent
- C. NH₃—polar covalent
- D. Br₂—polar covalent

9. Which compound contains ionic bonds?

- A. NaBr(s) B. HBr(g)
C. C₆H₁₂O₆(s) D. CO₂(g)

10. What is the total number of pairs of electrons shared in a molecule of N_2 ?

- A. one pair B. two pairs
- C. three pairs D. four pairs

11. Which type of bond is present in copper wire?

- A. covalent B. ionic
- C. electrovalent D. metallic

12. The bonding in NH_3 is most similar to the bonding in

- A. H_2O B. $NaCl$ C. MgO D. KF

13. Which substance contains a polar covalent bond?

- A. Na_3N B. Mg_3N_2
- C. NH_3 D. N_2

14. The bonds in BaO are best described as

- A. covalent, because valence electrons are shared
- B. covalent, because valence electrons are transferred
- C. ionic, because valence electrons are shared
- D. ionic, because valence electrons are transferred

15. A white crystalline salt conducts electricity when it is melted and when it is dissolved in water. Which type of bond does this salt contain?

- A. ionic B. metallic
- C. covalent D. network

CHEMICAL REACTIONS

Name: _____

Period: _____

Date: _____

QUIZ: Predicting the Products of Chemical Reactions

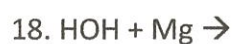
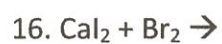
Identify each reaction below as synthesis, decomposition, double replacement or combustion. Then, predict the products. **FOR DOUBLE REPLACEMENT REACTIONS**, determine whether each product is soluble (aq) or insoluble (s). You do NOT need to balance the equations.

Reaction Type (S, D, DR, C)	Chemical Equation
	1. $\text{Mg} + \text{I}_2 \rightarrow$
	2. $\text{LiCl} \rightarrow$
	3. $\text{H}_2\text{SO}_4 + \text{Na}_2\text{CO}_3 \rightarrow$
	4. $\text{Al} + \text{O}_2 \rightarrow$
	5. $\text{CaCl}_2 + \text{H}_2\text{S} \rightarrow$
	6. $\text{Na} + \text{P} \rightarrow$
	7. $\text{BaO} + \text{LiF} \rightarrow$

Reaction Type (S, D, DR, C)	Chemical Equation
	8. $\text{NaBr} + \text{Ca}(\text{OH})_2 \rightarrow$
	9. $\text{C}_5\text{H}_9\text{O} + \text{O}_2 \rightarrow$
	10. $\text{H}_3\text{PO}_4 + \text{Ca} \rightarrow$
	11. $\text{Li}_3\text{N} + \text{NH}_4\text{NO}_3 \rightarrow$
	12. $\text{HBr} + \text{AlCl}_3 \rightarrow$
	13. $\text{FeSO}_4 + \text{Pb}^{+2} \rightarrow$
	14. $\text{Al}_2\text{S}_3 \rightarrow$
	15. $\text{H}_3\text{PO}_4 + \text{GaBr}_3 \rightarrow$

BONUS

Determine whether each single replacement reaction will occur. If it will occur, predict the products.



Name: _____

Period: _____

Date: _____

Quiz: Predicting the Products of Chemical Reactions

Directions: Predict the products of the following reactions. For double replacement reactions, determine each product's solubility.



Name: _____

Period: _____

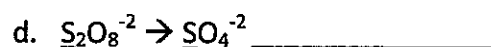
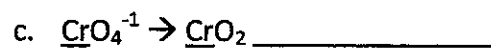
Date: _____

Oxidation-Reduction Reactions Quiz

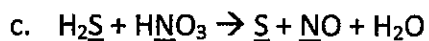
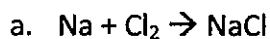
1. Determine the oxidation number of the elements in each of the following compounds:

Compound	Element 1	Element 2	Element 3
MnO_4^{-1}			
SO_3^{-2}			
$\text{Cr}(\text{OH})_4$			

2. Identify each half reaction as either an **oxidation (O)** or **reduction (R)** reaction.



3. Identify the substance being oxidized and reduced in each of the following reactions:



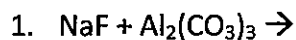
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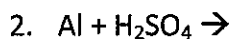
Honors Chemistry Chemical Reactions Test

Part 1: Chemical Equations



- Type of reaction: _____
- Predict the products
- Balance the equation
- Determine the solubility of each new compound

FINAL EQUATION:

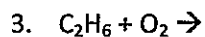


- Type of reaction: _____
- Predict the products
- Balance the equation
- Determine the solubility of each new compound
- Identify which element is oxidized and reduced

Oxidized: _____

Reduced: _____

FINAL EQUATION:



- Type of reaction: _____
- Predict the products
- Balance the equation

FINAL EQUATION:

Part 2: Multiple Choice

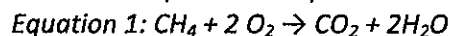
Choose the best answer to each of the following questions.

- In the reaction $2 \text{ZnS} + 3 \text{O}_2 \rightarrow 2 \text{ZnO} + 2 \text{SO}_2$, the oxidation number of sulfur changes from
 - 0 to -2
 - 2 to +6
 - 2 to +4
 - +2 to +4
- In the reaction $2 \text{KCl} \rightarrow 2 \text{K} + \text{Cl}_2$, potassium is
 - Reduced by losing electrons
 - Reduced by gaining electrons
 - Oxidized by losing electrons
 - Oxidized by gaining electrons
- What happens to reducing agents in chemical reactions?
 - Reducing agents gain protons
 - Reducing agents gain electrons
 - Reducing agents are oxidized
 - Reducing agents are reduced
- Which is a redox reaction?
 - $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
 - $2 \text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2 \rightarrow 2 \text{NH}_3 + 2 \text{H}_2\text{O} + \text{CaCl}_2$
 - $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 - $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$

Part 3: Short Answer

Answer each of the following questions in complete sentences.

16. Early scientists defined oxidation as a chemical reaction in which oxygen combined with another element to produce an oxide of the element. An example of oxidation based on this definition is the combustion of methane. This reaction is represented by the balanced equation below.



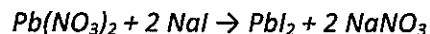
The definition of oxidation has since been expanded to include many reactions that do not involve oxygen. An example of oxidation based on this expanded definition is the reaction between magnesium ribbon and powdered sulfur when heated in a crucible. This reaction is represented by the balanced equation below.



- A. State why early scientists classified the reaction represented by equation 1 as oxidation.

- B. Determine the change in oxidation number of carbon in equation 1.

17. In a laboratory investigation, a solution that contains 13.2 grams of $\text{Pb}(\text{NO}_3)_2$ reacts completely with a solution that contains 12.0 grams of NaI , producing 18.4 grams of PbI_2 and an undetermined mass of a second product, NaNO_3 . This reaction is represented by the balanced equation below.



- A. Identify the compound produced that is insoluble in water. Justify your answer.

B. Determine the mass of NaNO_3 produced. Explain how you calculated your answer.

18. A student conducts an experiment to determine how the temperature of water affects the rate at which an antacid tablet dissolves in the water. The student has three antacid tablets of the same size and composition. The student drops one tablet into each of three beakers containing 200 milliliters of water at different temperatures and measures the time it takes for each tablet to completely dissolve. The results are shown in the table below.

Dissolving Data for Three Antacid Tablets

Beaker	Original Temperature of Water (Celsius)	Time for Tablet to Dissolve (seconds)
1	20	40
2	30	25
3	40	10

Explain, in terms of collision theory, how water temperature influences the rate of dissolving.

Name: _____

Date: _____

1. Which is an example of a chemical reaction?

- A. nails rusting B. glass melting
C. sugar dissolving D. alcohol vaporizing

2. The following equations represent chemical reactions.

Chemical Reactions

1	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$
2	$\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
3	$\text{Mg} + \text{Cl}_2 \rightarrow \text{MgCl}_2$
4	$\text{NaOH} + \text{MgCl}_2 \rightarrow \text{NaCl} + \text{MgOH}$

Which equation shows that the total mass during a chemical reaction stays the same?

- A. 1 B. 2 C. 3 D. 4

3. $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$

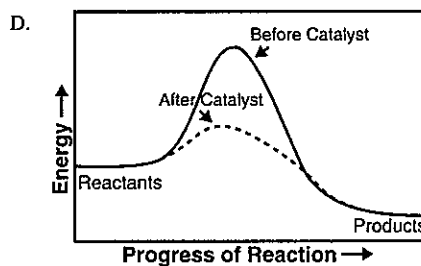
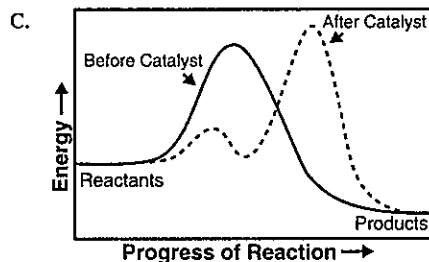
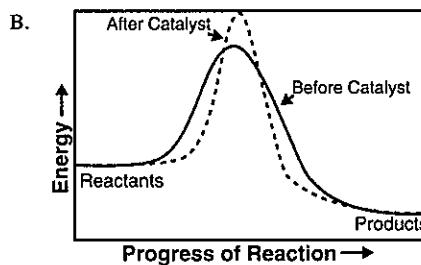
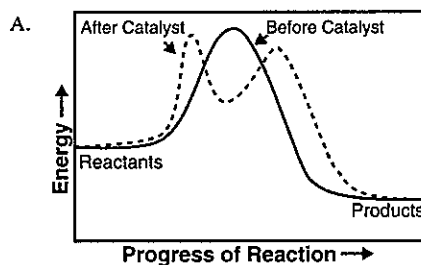
If the above reaction takes place inside a sealed reaction chamber, then which of these procedures will cause a decrease in the rate of reaction?

- A. raising the temperature of the reaction chamber
B. increasing the volume inside the reaction chamber
C. removing the CO_2 as it is formed
D. adding more CO to the reaction chamber

4. A catalyst can speed up the rate of a given chemical reaction by

- A. increasing the equilibrium constant in favor of products.
B. lowering the activation energy required for the reaction to occur.
C. raising the temperature at which the reaction occurs.
D. increasing the pressure of reactants, thus favoring products.

5. Which reaction diagram shows the effect of using the appropriate catalyst in a chemical reaction?

6. $\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

This chemical equation represents the combustion of propane. When correctly balanced, the coefficient for water is

- A. 2. B. 4. C. 8. D. 16.

7. Which of the following is a balanced equation for the combustion of ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)?

A. $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
 B. $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
 C. $\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
 D. $\text{CH}_3\text{CH}_2\text{OH} + 2\text{O}_2 \rightarrow 3\text{CO}_2 + 2\text{H}_2\text{O}$

8. $\text{NH}_3(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$

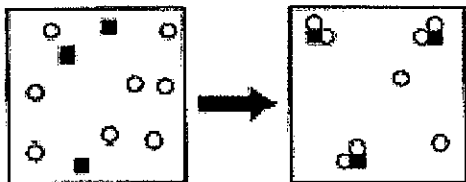
When the reaction above is completely balanced, the coefficient for NH_3 will be

A. 2. B. 3. C. 4. D. 6.

9. Which of the following processes involving cola represents a chemical change?

A. Liquid cola freezing into solid form
 B. Ice cubes melting and changing into liquid water in a glass of cola
 C. Water droplets condensing on the outside of a glass of cold cola
 D. Carbonic acid in cola changing into carbon dioxide and water

10. The reaction of element X (●) with element Y (○) is represented in the following diagram:



Which equation properly describes the reaction between X and Y?

A. $3\text{X} + 8\text{Y} \rightarrow \text{X}_3\text{Y}_8$ B. $3\text{X} + 6\text{Y} \rightarrow \text{X}_3\text{Y}_6$
 C. $\text{X} + 2\text{Y} \rightarrow \text{XY}_2$ D. $3\text{X} + 8\text{Y} \rightarrow 3\text{XY}_2 + 2\text{Y}$

11. A balanced chemical equation reflects the idea that the mass of the products

A. is greater than the mass of the reactants.
 B. is less than the mass of the reactants.
 C. equals the mass of the reactants.
 D. is not related to the mass of the reactants.

12. $2\text{Na}(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NaCl}(\text{s})$

s = solid

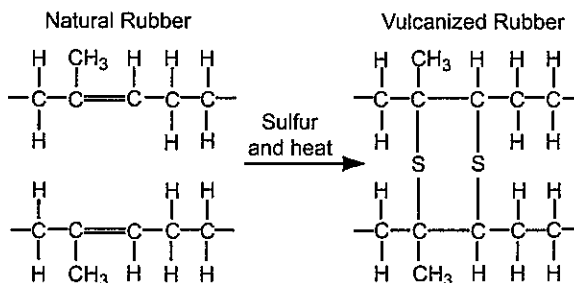
g = gas

The equation represents a chemical change because _____.

A. it is balanced
 B. the product is solid
 C. a new substance is produced
 D. there are two substances on the reactant side

13. The tires on most cars are not made of natural rubber because it becomes brittle in the cold and sticky in the heat. Instead, natural rubber is vulcanized by adding sulfur and heat, making it stronger and more elastic. This process is represented chemically in the diagram below.

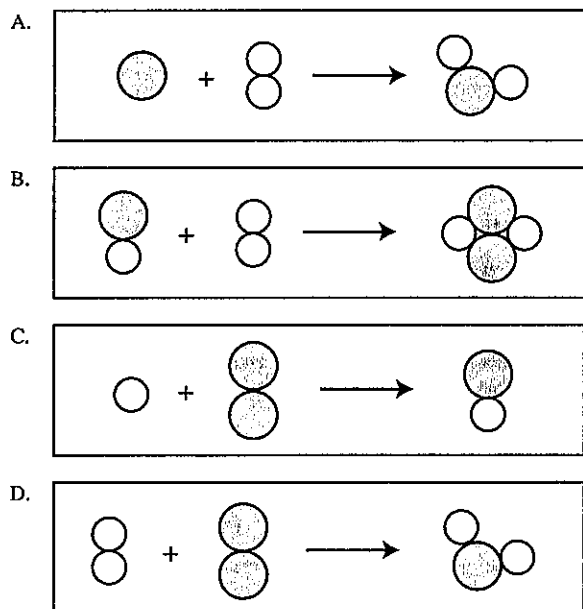
Vulcanization Process



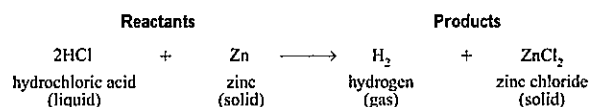
The complete combustion or burning of **natural rubber** will produce _____.

A. hydrogen and oxygen B. oxygen and water
 C. hydrogen gas and water D. carbon dioxide and water.

14. The law of conservation of mass can be demonstrated by a chemical reaction. Which of the following models of a chemical reaction *best* represents the law of conservation of mass?

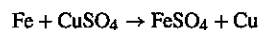


15. In the chemical reaction shown below, all of the HCl and Zn will react to form H_2 and $ZnCl_2$.



Which of the following statements describes the result of this reaction?

- A. The hydrogen gas will have a mass of zero.
- B. The zinc chloride will have less mass than the zinc.
- C. The mass of the products will equal the mass of the reactants.
- D. The mass of the hydrogen atoms will decrease in the products.
16. Copper in the compound $CuSO_4$ can be isolated in the following reaction with iron.



What type of reaction is shown above?

- A. decomposition B. synthesis
- C. single displacement D. double displacement

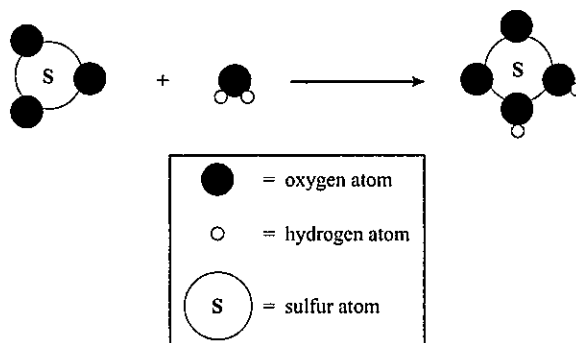
17. A student heated a 10 g sample of a compound in an open container. A chemical reaction occurred. The mass of the sample was measured again and found to be less than before. Which of the following explains the change in mass of the sample?

- A. The heat caused the compound to become less dense.
- B. The reaction gave off more heat than was added.
- C. Some of the lighter atoms were converted to energy.
- D. One of the reaction products was a gas.

18. Which of the following chemical reactions is a decomposition reaction?

- A. $BaCO_3 \rightarrow BaO + CO_2$
- B. $2Ca + O_2 \rightarrow 2CaO$
- C. $3Br_2 + 2FeI_3 \rightarrow 2FeBr_3 + 3I_2$
- D. $MgCl_2 + H_2SO_4 \rightarrow MgSO_4 + 2HCl$

19. The figure below represents a reaction.

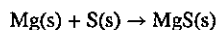


What type of reaction is shown?

- A. synthesis B. decomposition
- C. single displacement D. double displacement
20. Which of the following chemical equations is balanced correctly?

- A. $C_6H_6 + O_2 \rightarrow 2CO_2 + 3H_2O$
- B. $CS_2 + 3Cl_2 \rightarrow CCl_4 + S_2Cl_2$
- C. $B_2O_3 + 2C \rightarrow B_4C + CO$
- D. $Cl_2 + NaI \rightarrow 2NaCl + I_2$

21. Under certain conditions, solid magnesium (Mg) and solid sulfur (S) can combine and form magnesium sulfide (MgS). The oxidation-reduction reaction is shown below.



Which of the following is the oxidation number for Mg in MgS in this reaction?

- A. +1 B. -1 C. +2 D. -2

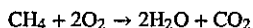
22. A balanced equation is shown below.



Which of the following statements correctly compares the mass of the reactant with the mass of the products in this equation?

- A. The mass of the reactant is half the mass of the products.
B. The mass of the reactant is twice the mass of the products.
C. The mass of the reactant is one-fourth the mass of the products.
D. The mass of the reactant is the same as the mass of the products.

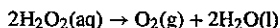
23. Methane gas burns in the presence of oxygen to form water vapor and carbon dioxide. The balanced equation for this reaction is below.



Which of the following is the oxidation number of carbon in CO_2 ?

- A. -2 B. 0 C. +2 D. +4

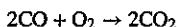
24. Hydrogen peroxide decomposes according to the equation below.



Which of the following actions will slow down the rate of this reaction?

- A. adding a catalyst
B. adding more H_2O_2
C. decreasing the temperature
D. removing O_2 that is produced

25. The reaction below shows carbon monoxide burning in oxygen.



What is the change in the oxidation number of carbon for this reaction?

- A. +2 to +1 B. +2 to +4 C. +4 to +1 D. +4 to +2

26. When pure N_2O_5 is heated under certain conditions, O_2 and NO_2 are produced. What type of reaction is this?

- A. combustion B. decomposition
C. double displacement D. synthesis (combination)

27. Which of the following equations represents the law of conservation of mass?

- A. $\text{H}_2\text{O} - \text{H}_2 + \text{O}_2$ B. $2\text{H} + 2\text{O} - 2\text{H}_2\text{O}$
C. $2\text{H}_2\text{O} - 2\text{H}_2 + \text{O}_2$ D. $\text{H}_2 + \text{O}_2 - \text{H}_2\text{O} + \text{H}_2\text{O}_2$

28. A chemical reaction produces two new substances, and each product has a mass of 25 grams. What was the total mass of the reactants?

- A. 25 grams B. 50 grams
C. 75 grams D. 100 grams

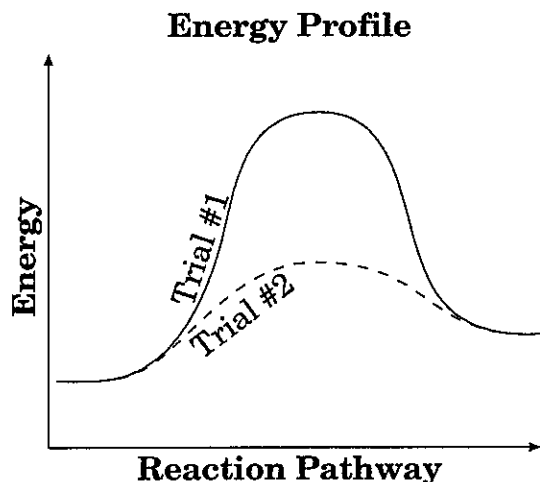
29. Which equation represents a double replacement reaction?

- A. $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$
B. $\text{CaBr}_2 + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 + 2\text{NaBr}$
C. $\text{Zn} + \text{S} \rightarrow \text{ZnS}$
D. $2\text{Li} + \text{FeBr}_2 \rightarrow 2\text{LiBr} + \text{Fe}$

30. Solutions of lead(II) nitrate and potassium dichromate are mixed. The solution turns cloudy and yellow. Solid yellow particles fall to the bottom of the beaker. Which statement *best* describes this reaction?

- A. A precipitate formed.
B. A gas formed.
C. The reaction is exothermic.
D. The reaction is endothermic.

31. This graph represents the change in energy for two laboratory trials of the same reaction.



Which factor could explain the energy difference between the trials?

- A. Heat was added to trial #2.
 B. A catalyst was added to trial #2.
 C. Trial #1 was stirred.
 D. Trial #1 was cooled.
32. Which equation represents a single replacement reaction that can occur?

- A. $\text{F}_2 + 2\text{NaCl} \rightarrow 2\text{NaF} + \text{Cl}_2$
 B. $\text{Cl}_2 + 2\text{NaF} \rightarrow 2\text{NaCl} + \text{F}_2$
 C. $\text{Cu} + 2\text{NaCl} \rightarrow \text{CuCl}_2 + 2\text{Na}$
 D. $\text{Zn} + 2\text{NaF} \rightarrow \text{ZnF}_2 + 2\text{Na}$

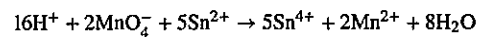
33. What products are formed when the metal potassium is added to water?

- A. K and H_2O B. KOH and H_2O
 C. K_2O and H_2 D. KOH and H_2

34. What is the oxidation number of the chromium atom in the $\text{Cr}_2\text{O}_7^{2-}$ ion?

- A. -6 B. -4 C. +4 D. +6

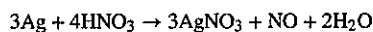
35. Consider this oxidation-reduction reaction:



Which represents the oxidation half-reaction?

- A. $\text{Sn}^{4+} + 2\text{e}^- \rightarrow \text{Sn}^{2+}$ B. $\text{Mn}^{6+} + 4\text{e}^- \rightarrow \text{Mn}^{2+}$
 C. $\text{Sn}^{2+} \rightarrow \text{Sn}^{4+} + 2\text{e}^-$ D. $\text{Mn} \rightarrow \text{Mn}^{2+} + 2\text{e}^-$

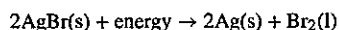
36. This balanced equation represents a chemical reaction:



Which substance undergoes reduction?

- A. Ag^0 B. H^+ C. N^{5+} D. O^{2-}

37. Consider this chemical equation:



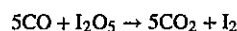
Which is true about the reaction?

- A. Silver is reduced. B. Bromine is reduced.
 C. Silver loses electrons. D. Bromine gains electrons.

38. Butane (C_4H_{10}) is used as the fuel in many portable lighters. When butane is completely combusted in oxygen, what is the coefficient for the water produced in the properly balanced equation that represents the reaction?

- A. 10 B. 8 C. 6 D. 4

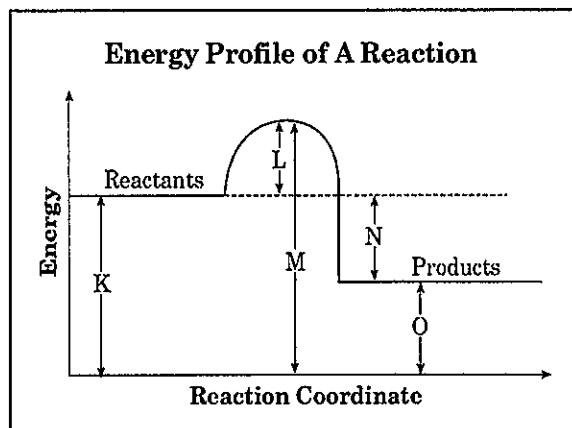
39. Consider the following balanced equation:



Which substance is the oxidizing agent?

- A. CO B. I_2O_5 C. CO_2 D. I_2

40. Use the graph below to answer the following question(s).



In the graph, which of the following is represented by the letter L?

- A. reaction heat B. progress of reaction
 C. catalytic effect D. activation energy

41. On the graph, which dimension would be changed if the rate of reaction were to be altered by a catalyst?

- A. K B. L C. N D. O

42. What is the oxidation number of sulfur in BaSO_4 ?

- A. -2 B. 0 C. +1 D. +6

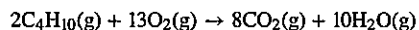
43. Consider this incomplete chemical equation:



What are the products of this equation?

- A. BaCl_2 and CuCl_2 B. BaCuCl_2 and Ba
C. BaCl_2 and Cu D. BaCu and Cl_2

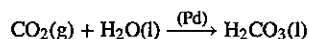
44. This balanced equation represents a chemical reaction.



What type of chemical reaction is represented by the equation?

- A. combustion B. decomposition
C. double replacement D. single replacement

45. This balanced equation represents a chemical reaction using palladium, Pd, as a catalyst.



Without palladium the reaction is slow and produces low concentrations of product. How does the palladium increase the speed of the reaction?

- A. The palladium reacts with the water.
B. The palladium lowers the activation energy.
C. The palladium purifies the carbon dioxide.
D. The palladium increases the reaction temperature.

46. Which pair of substances will likely undergo a single replacement reaction?

- A. Na and BaCl_2 B. Zn and BaCl_2
C. Ca and BaCl_2 D. K and BaCl_2

Multiple Choice

- A characteristic of ionic solids is that they
 - have high melting points
 - have low boiling points
 - conduct electricity
 - are noncrystalline
- A chemist performs the same tests on two homogeneous white crystalline solids, *A* and *B*. The results are shown in the accompanying table.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H ₂ O (grams per 100.0 g H ₂ O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

- both solids contain only ionic bonds
 - both solids contain only covalent bonds
 - solid A contains only covalent bonds and solid B contains only ionic bonds
 - solid A contains only ionic bonds and solid B contains only covalent bonds
- Which statement explains why a molecule of CH₄ is nonpolar?
 - The bonds between the atoms in a CH₄ molecule are polar.
 - The bonds between the atoms in a CH₄ molecule are ionic.
 - The geometric shape of a CH₄ molecule distributes the charges symmetrically.
 - The geometric shape of a CH₄ molecule distributes the charges asymmetrically.
 - Which molecule contains a nonpolar covalent bond?
 - HCl
 - F₂
 - CO₂
 - NH₃

- When ionic bonds are formed, metallic atoms tend to
 - lose electrons and become negative ions
 - lose electrons and become positive ions
 - gain electrons and become negative ions
 - gain electrons and become positive ions
- In a nonpolar covalent bond, electrons are
 - located in a mobile "sea" shared by many ions
 - transferred from one atom to another
 - shared equally by two atoms
 - shared unequally by two atoms
- Which pair of atoms will share electrons when a bond is formed between them?
 - Ba and I
 - Br and Cl
 - K and Cl
 - Li and I
- Which substance is correctly paired with its type of bonding?
 - NaBr—nonpolar covalent
 - HCl—nonpolar covalent
 - NH₃—polar covalent
 - Br₂—polar covalent
- Which compound contains ionic bonds?
 - NaBr(s)
 - HBr(g)
 - C₆H₁₂O₆(s)
 - CO₂(g)

10. What is the total number of pairs of electrons shared in a molecule of N_2 ?
- A. one pair B. two pairs
C. three pairs D. four pairs
11. Which type of bond is present in copper wire?
- A. covalent B. ionic
C. electrovalent D. metallic
12. The bonding in NH_3 is most similar to the bonding in
- A. H_2O B. NaCl C. MgO D. KF
13. Which substance contains a polar covalent bond?
- A. Na_3N B. Mg_3N_2
C. NH_3 D. N_2

14. The bonds in BaO are best described as
- A. covalent, because valence electrons are shared
B. covalent, because valence electrons are transferred
C. ionic, because valence electrons are shared
D. ionic, because valence electrons are transferred
15. A white crystalline salt conducts electricity when it is melted and when it is dissolved in water. Which type of bond does this salt contain?
- A. ionic B. metallic
C. covalent D. network

- Which event must always occur for a chemical reaction to take place?
 - formation of a precipitate
 - formation of a gas
 - effective collisions between reacting particles
 - addition of a catalyst to the reaction system
- In which type of reaction do two or more substances combine to produce a single substance?
 - synthesis
 - decomposition
 - single replacement
 - double replacement
- The reaction $\text{BaCO}_3 \rightarrow \text{BaO} + \text{CO}_2$ involves
 - oxidation, only
 - reduction, only
 - both oxidation and reduction
 - neither oxidation nor reduction
- Which change affects both the rate and the activation energy of chemical reaction?
 - a temperature increase
 - a temperature decrease
 - the addition of more reactant
 - the addition of a catalyst
- Charcoal reacts with oxygen according to the equation $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$. Which of the following changes would cause the greatest increase in the rate of reaction?
 - decreasing the concentration of $\text{O}_2\text{(g)}$
 - decreasing the pressure of $\text{O}_2\text{(g)}$
 - using charcoal in powdered form
 - using charcoal in lump form

- Which particles are gained and lost during a redox reaction?
 - electrons
 - protons
 - neutrons
 - positrons
- During a laboratory activity to investigate reaction rate, a student reacts 1.0-gram samples of solid zinc with 10.0-milliliter samples of HCl(aq) . The table below shows information about the variables in five experiments the student performed.

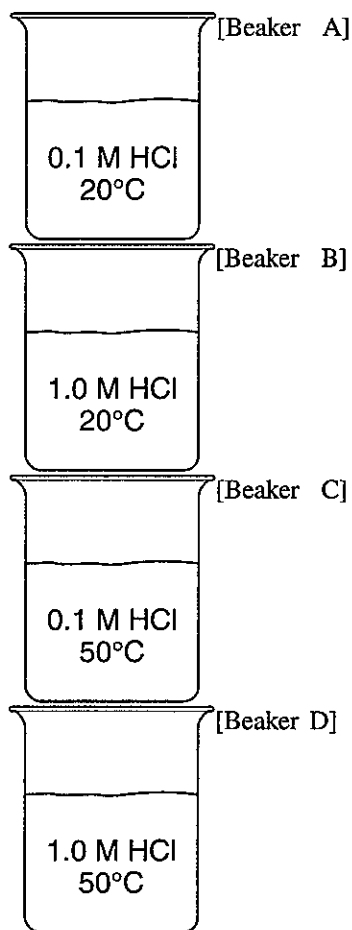
Reaction of Zn(s) with HCl(aq)

Experiment	Description of Zinc Sample	HCl(aq) Concentration (M)	Temperature (K)
1	lumps	0.10	270.
2	powder	0.10	270.
3	lumps	0.10	290.
4	lumps	1.0	290.
5	powder	1.0	280.

Which two experiments can be used to investigate the effect of the concentration of HCl(aq) on the reaction rate?

- 1 and 3
 - 1 and 5
 - 4 and 2
 - 4 and 3
- Which process represents a chemical change?
 - melting of ice
 - corrosion of copper
 - evaporation of water
 - crystallization of sugar
 - Which metal will react with HCl(aq) to produce hydrogen gas?
 - Au
 - Hg
 - Cu
 - Zn

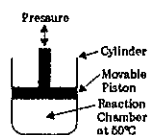
10. In each of the four beakers shown below, a 2.0-centimeter strip of magnesium ribbon reacts with 100 milliliters of HCl(aq) under the conditions shown.



In which beaker will the reaction occur at the fastest rate?

- A. A B. B C. C D. D

11. The reaction $A(g) + B(g) \rightarrow C(g)$ is occurring in the apparatus shown. The rate of reaction can be decreased by increasing the

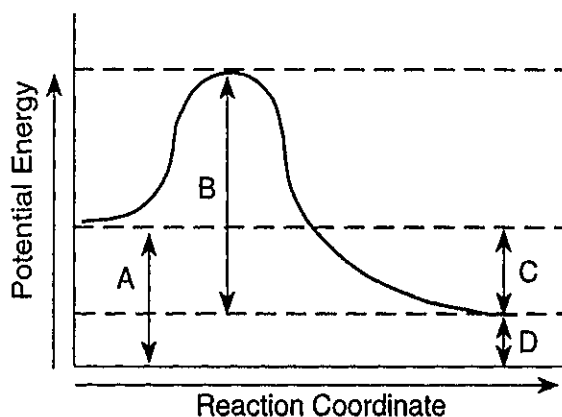


- A. pressure on the reactants
 B. temperature of the reactants
 C. concentration of reactant A(g)
 D. volume of the reaction chamber

12. In the reaction $Mg + 2HCl \rightarrow MgCl_2 + H_2$, the magnesium

- A. gains electrons and is reduced
 B. gains electrons and is oxidized
 C. loses electrons and is reduced
 D. loses electrons and is oxidized

13. The potential energy diagram of a chemical reaction is shown.



Which arrow represents the part of the reaction most likely to be affected by the addition of a catalyst?

- A. A B. B C. C D. D

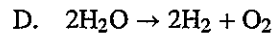
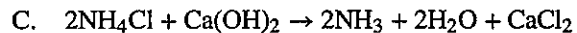
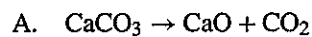
14. A redox reaction always involves

- A. a change in oxidation number
 B. a change in phase
 C. the transfer of protons
 D. the formation of ions

15. Which is an oxidation-reduction reaction?

- A. $4Na + O_2 \rightarrow 2Na_2O$
 B. $3O_2 \rightarrow 2O_3$
 C. $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
 D. $KI \rightarrow K^+ + I^-$

16. Which is a redox reaction?



17. In the reaction $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$, the oxidation number of sulfur changes from

A. 0 to -2

B. -2 to +4

C. -2 to +6

D. +2 to +4

18. Given the reaction: $2\text{KCl}(\ell) \rightarrow 2\text{K}(\text{s}) + \text{Cl}_2(\text{g})$. In this reaction, the K^+ ions are

A. reduced by losing electrons

B. reduced by gaining electrons

C. oxidized by losing electrons

D. oxidized by gaining electrons

19. What happens to reducing agents in chemical reactions?

A. Reducing agents gain protons.

B. Reducing agents gain electrons.

C. Reducing agents are oxidized.

D. Reducing agents are reduced.

1. Which of these is an example of an exothermic chemical process?

- A. evaporation of water B. melting ice
C. photosynthesis of glucose D. combustion of gasoline

2. Which of the following equations best represents the burning of a log?

- A. $\text{Wood} + \text{CO}_2 \rightarrow \text{O}_2 + \text{H}_2\text{O} + \text{energy}$
B. $\text{Wood} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy}$
C. $\text{Wood} + \text{H}_2\text{O} \rightarrow \text{O}_2 + \text{CO}_2 + \text{energy}$
D. $\text{Wood} \rightarrow \text{CO}_2 + \text{O}_2 + \text{H}_2\text{O} + \text{energy}$

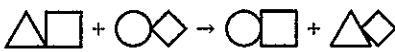
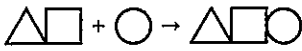

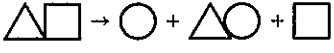
3. Dee adds five grams of a chemical to one liter of liquid and observes a reaction. If the reaction is **endothermic**, what will happen?

- A. The volume of the liquid will increase.
B. The volume of the liquid will decrease.
C. The temperature of the liquid will increase.
D. The temperature of the liquid will decrease.

4. Which of the following equations represents the law of conservation of mass?

- A. $\text{H}_2\text{O} - \text{H}_2 + \text{O}_2$ B. $2\text{H} + 2\text{O} - 2\text{H}_2\text{O}$
C. $2\text{H}_2\text{O} - 2\text{H}_2 + \text{O}_2$ D. $\text{H}_2 + \text{O}_2 - \text{H}_2\text{O} + \text{H}_2\text{O}_2$

5. Which of the following diagrams represents a single displacement (replacement) reaction?

- A. 
B. 
C. 
D. 

6. Which of the following is the balanced equation for the decomposition of hydrogen peroxide (H_2O_2) into water and oxygen gas?

- A. $\text{H}_2\text{O}_2 \rightarrow 2\text{H} + 2\text{O}$ B. $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
C. $2\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + 2\text{O}_2$ D. $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

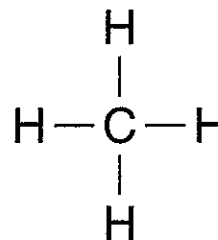
7. Which of the following statements describes an exothermic reaction but *not* an endothermic reaction?

- A. Energy is destroyed during the reaction.
B. Energy is used to form chemical bonds.
C. Energy is used to break chemical bonds.
D. Energy is released as heat during the reaction.

8. Which of the following statements describes the difference between endothermic and exothermic chemical reactions?

- A. Energy is absorbed in endothermic reactions but is released in exothermic reactions.
B. Energy is conserved in endothermic reactions but is not conserved in exothermic reactions.
C. Endothermic reactions involve changes in the nucleus of an atom, but exothermic reactions do not involve changes in the nucleus.
D. Endothermic reactions occur when electrons are shared between atoms, but exothermic reactions occur when electrons are transferred between atoms.

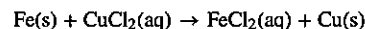
9. The diagram below represents one molecule of methane (CH_4).



Which of the following is a balanced equation for the synthesis of methane from carbon and hydrogen?

- A. $\text{C} + \text{H} \rightarrow \text{CH}_4$ B. $\text{C}_4 + \text{H} \rightarrow \text{CH}_4$
C. $\text{C} + 2\text{H}_2 \rightarrow \text{CH}_4$ D. $\text{C}_2 + 4\text{H} \rightarrow \text{CH}_4$

10. A student adds iron filings to a copper(II) chloride solution at room temperature. A balanced equation for the reaction that occurs is shown below.



Which of the following changes would *most likely* increase the reaction rate?

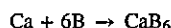
- A. using larger pieces of iron
B. performing the reaction in an ice bath
C. decreasing the volume of the CuCl_2 solution
D. increasing the concentration of the CuCl_2 solution

11. A student observed that the rate of a chemical reaction increased as the temperature of the system increased.

Which of the following statements *best* explains why thermal energy caused an increase in the reaction rate?

- A. The surface area of the product particles decreased.
- B. The collision rate of the reactant particles increased.
- C. The concentrations of the reactant particles increased.
- D. The concentrations of the product particles decreased.

12. Calcium and boron react to form calcium boride, as represented by the chemical equation below.



Which type of reaction is shown by this equation?

- A. combination
- B. decomposition
- C. double displacement
- D. single displacement

13. Students combined baking soda and vinegar to demonstrate a chemical reaction.

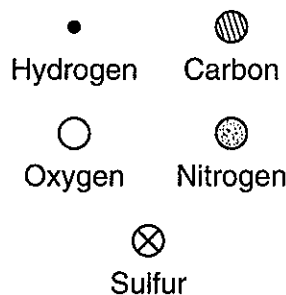
What indicates that a chemical reaction occurred?

- A. the formation of bubbles
- B. a reduction in total mass
- C. the disappearance of atoms
- D. an increase in the number of atoms

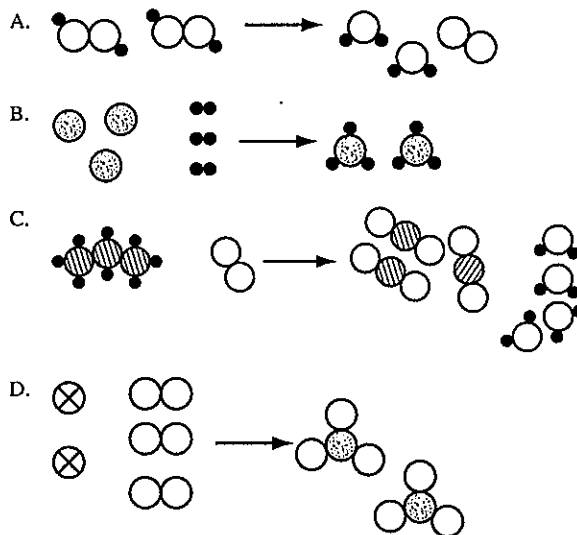
14. Which of the following is an example of a chemical change?

- A. melting chocolate
- B. freezing water
- C. turning iron to rust
- D. adding salt to water

15. Each circle shown below represents a different atom.



Which diagram illustrates that matter is always conserved during a chemical reaction?



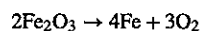
16. Chemical X has a mass of 5 grams, and chemical Y has a mass of 10 grams. If the two chemicals are mixed and a complete chemical reaction takes place, what is *most likely* the mass of the product?

- A. 5 grams
- B. 10 grams
- C. 15 grams
- D. 50 grams

17. A teacher demonstrates a decomposition reaction. Which would be a correct demonstration?

- A. burning magnesium in the presence of oxygen to produce magnesium oxide
- B. burning methane in the presence of oxygen to produce carbon dioxide and water
- C. running an electrical current through water to produce hydrogen and oxygen
- D. reacting iron with oxygen to produce iron(III) oxide

18. A chemical reaction is represented by this equation.



What is a product of this chemical reaction?

- A. FeO
- B. F
- C. O₂
- D. Fe₂O₃

19. Which equation represents a double replacement reaction?

- A. $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$
- B. $\text{CaBr}_2 + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 + 2\text{NaBr}$
- C. $\text{Zn} + \text{S} \rightarrow \text{ZnS}$
- D. $2\text{Li} + \text{FeBr}_2 \rightarrow 2\text{LiBr} + \text{Fe}$

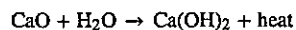
20. The reaction of CaO and water is exothermic. A student mixes the two chemicals in a test tube and touches the side of the test tube. Which statement describes the student's observation?

- A. The test tube becomes hot as heat is released.
- B. The test tube becomes hot as heat is absorbed.
- C. The test tube becomes cold as heat is released.
- D. The test tube becomes cold as heat is absorbed.

21. Solutions of lead(II) nitrate and potassium dichromate are mixed. The solution turns cloudy and yellow. Solid yellow particles fall to the bottom of the beaker. Which statement *best* describes this reaction?

- A. A precipitate formed.
- B. A gas formed.
- C. The reaction is exothermic.
- D. The reaction is endothermic.

22. How is this reaction classified?



- | | |
|------------------|-----------------------|
| A. endothermic | B. exothermic |
| C. decomposition | D. double replacement |

Name: _____

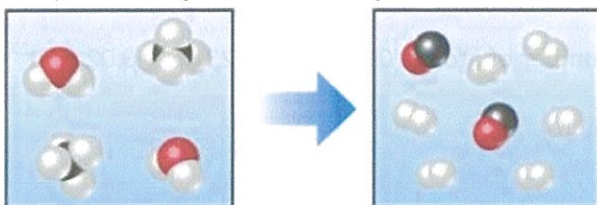
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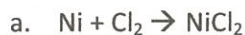
Questions I Ended Up Cutting from Your Final Because It Was Too Long



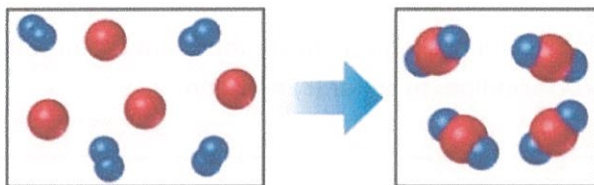
1. The most common charge associated with silver in its compounds is +1. Indicate the chemical formulas you would expect for compounds formed between Ag and (a) iodine (b) sulfur (c) nitrogen.
2. Determine the empirical and molecular formulas of the following:
 - a. The organic solvent benzene, which has six carbon atoms and six hydrogen atoms
 - b. Silicon tetrachloride, which is used in the manufacture of computer chips
3. Write a balanced chemical equation for the reaction of sulfur trioxide gas with water to produce sulfuric acid. Include states of matter in the equation. *This exact style of question is on your exam.*
4. The following temperature represents a high-temperature reaction between CH_4 and H_2O . Based on this reaction, how many moles of each product can be obtained if you begin with 4.0 mol CH_4 ?



5. Which element is oxidized and which is reduced in the following reactions?



6. The reaction between reactant A (blue spheres) and reactant B (red spheres) is shown in the following diagram:



Based on this diagram, which equation best describes this reaction?

- a. $\text{A}_2 + \text{B} \rightarrow \text{A}_2\text{B}$
- b. $2 \text{A} + \text{B}_4 \rightarrow 2 \text{AB}_2$
- c. $\text{A}_2 + 4 \text{B} \rightarrow 2 \text{AB}_2$
- d. $\text{A} + \text{B}_2 \rightarrow \text{AB}_2$

7. The compound chloral hydrate, known in detective stories as knockout drops, is composed of 14.52% C, 1.83% H, 64.30% Cl, and 19.35% O by mass and has a molar mass of 165.4 g/mol.

a. What is the empirical formula of this substance?

b. What is the molecular formula of this substance?

c. Draw the Lewis structure of the molecule, assuming that all three Cl atoms bond to a single C atom and that there is a C-C bond and two C-O bonds in the compound.

8. Rank the following samples in order of increasing number of atoms: 0.5 mol H_2O , 23g Na, 6.02×10^{23} N_2 molecules.

9. A sample of 5.53 g of $\text{Mg}(\text{OH})_2$ is added to 25.0 mL of 0.2 M HNO_3 .

- a. Write the balanced chemical equation for the reaction that occurs.
- b. Which is the limiting reactant in the reaction? (Hint: determine the number of moles of HNO_3 present in 25 mL of 0.2 M HNO_3).

10. Determine the oxidation number for the indicated element in each of the following substances:

- a. S in SO_2
- b. C in COCl_2
- c. Mn in MnO_4^-

11. Draw Lewis structures for the following:

- | | |
|--------------------------|---|
| a. H_2CO | d. ClO_2^- |
| b. CO | e. H_2O_2 |
| c. SF_2 | f. C_2F_6 (contains a C-C bond) |

12. What is wrong with the following electron configurations?

- a. $1s^2 2s^2 3p^1$



13. The volume of an adult's stomach ranges from about 50 mL when empty to 1 L when full. If its volume is 400 mL and its contents have a pH of 2, how moles of H^+ does it contain? (I AM SO SAD ABOUT CUTTING THIS QUESTION.)

14. Will precipitation occur when the following solutions are mixed? If so, write a chemical equation for the reaction. You do NOT need to balance the equation.

